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HYMO: PROBLEM-ORIENTED COMPUTER LANGUAGE FOR HYDROLOGIC MODELING

Users Manual

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HYMO: PROBLEM-ORIENTED COMPUTER LANGUAGE FOR HYDROLOGIC MODELING

Users Manual

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INTRODUCTION

HYMO (7)³ is a problem-oriented computer language for modeling surface runoff and sediment yield from watersheds. The language is called HYMO from the words "hydrologic model." HYMO was designed for planning flood prevention projects, forecasting floods, and research studies. It consists of a main program and 16 subroutines written in FORTRAN IV, but it can be used by hydrologists with little knowledge of computer programming. The language provides 17 commands for the hydrologist to use in any sequence for application to any watershed.

HYMO was designed to transform rainfall data into runoff hydrographs and to route these hydrographs through streams and valleys or reservoirs. It will also compute the amount of sediment produced by a storm at any point on a watershed. It will be useful to research hydrologists in studying the effects of watershed and storm characteristics on the flood hydrograph. HYMO is also a good research tool for testing

hydrologic procedures; for example, a new flood-routing method could be added to HYMO and tested easily, because the inflow hydrographs and the rating curves are available in a HYMO program.

HYMO is flexible. Present hydrologic procedures can be modified or deleted, and other hydrologic procedures can be added by hydrologists familiar with FORTRAN IV programming. Adding a new command simply requires the addition of a new subroutine.

HYMO is efficient, practical, and generally applicable. HYMO programs can be written and the results interpreted by hydrologists who have no conventional computer programming experience. The hydrologic procedures used in HYMO are practical — required inputs are easy to obtain for most watersheds.

HYMO was written for the IBM 360-65 computer, but it could be run on an IBM 1130 with little modification. The storage requirement is about 73 K.

OPERATION OF HYMO

HYMO consists of a main program and 16 subroutines. The HYMO card deck is set up in the following order:

1. Main program.
2. Subroutines.
3. A data card containing the number of commands in the command table.
4. A data card containing the ZALFA array.
5. Seventeen data cards containing the command table.
6. The users program deck consisting of program and data cards.

A printout of the main program, subroutines, ZALFA array, and command table is given in the appendix.

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³Italicized number in parentheses refer to items in "Literature Cited" preceding the appendix.

The main program reads the command table and then calls the HONDO subroutine (2) to read a program data card. Subroutine HONDO determines the command name and number by comparing columns 1 through 20 of the program data card with the command table. Then HONDO determines individual data items by comparing columns 21 through 80 of the pro-

gram data card with the ZALFA array. The data are placed in an array and returned to the main program. Based on the command number, the main program calls the proper subroutine to do the desired calculations. When the calculations are complete, control is returned to the main program, and HONDO is called again to read the next program card.

HYDROLOGIC PROCEDURES USED IN HYMO

The procedures used in HYMO were selected because of their accuracy, general applicability, practicality of inputs, and computational efficiency. For most watersheds the input is easy to obtain, and the procedures produce reasonably accurate results without excessive computer time.

Hydrograph Computation

When flood routing is performed, a watershed is divided into many small areas according to its hydraulic characteristics. The hydrographs from these areas must be estimated, since streamflow measurements are seldom available. A procedure for computing unit hydrographs was developed previously (4). A modification of this procedure is used in HYMO. Unit hydrographs are divided into three parts for computation (fig. 1). From the beginning of rise to the inflection point, t_0 , the hydrograph is computed by the two-parameter gamma distribution equation

$$q = q_p \left[\frac{t}{t_p} \right]^{(n-1)} e^{-(1-n)(t/t_p-1)} \quad (1)$$

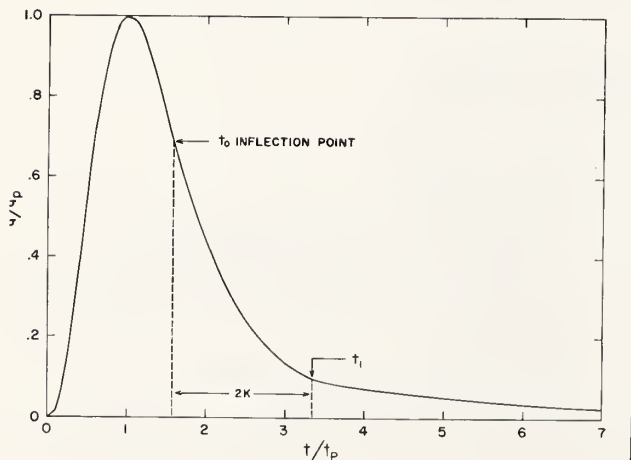


Figure 1. Dimensionless unit hydrograph.

where q = flow rate in cubic feet per second at time t ,
 q_p = peak flow rate in cubic feet per second,
 t_p = time to peak in hours,
 and n = dimensionless parameter.

From t_0 to t_1 ($t_1 = t_0 + 2K$) the hydrograph is computed by the recession depletion equation

$$\frac{t_0 - t}{K} \quad (2)$$

$$q = q_0 e$$

where q_0 = flow rate at the inflection point,
 t_0 = time at the inflection point,
 and K = recession constant in hours.

From t_1 to ∞ the recession depletion equation becomes

$$\frac{t_1 - t}{K_1} \quad (3)$$

$$q = q_1 e$$

where q_1 = flow rate at t_1 ,
 and $K_1 = 3K$ = second recession constant.

The dimensionless shape parameter, n , is a function of K/t_p , as shown in figure 2. The peak flow rate is computed by the equation

$$q_p = \frac{BAQ}{t_p} \quad (4)$$

where B = a watershed parameter, a function of n as shown in figure 3,

A = watershed area in square miles,

and Q = volume of runoff in inches.

Therefore, the entire unit hydrograph can be computed if K and t_p are known. K and t_p can be determined by hydrograph analysis (4) for gaged watersheds. To compute K and t_p for ungaged watersheds, HYMO uses the equations

$$K = 27.0A^{0.231}SLP^{-0.777}(L/W)^{0.124} \quad (5)$$

$$\text{and } tp = 4.63A^{0.422}SLP^{-0.46}(L/W)^{0.133} \quad (6)$$

where SLP = difference in elevation in feet, divided by flood-plain distance in miles, between watershed outlet and most distant point on the watershed,

and L/W = watershed length-width ratio.

Storm hydrographs are computed by convolving unit hydrographs with incremental source runoff. To compute incremental source runoff, the mass rainfall curve is broken into equal time increments, and the Soil Conservation Service (SCS) rainfall-runoff relationship (3) is applied. The SCS rainfall-runoff relationship is expressed in a set of numbered curves. The SCS National Engineering Handbook (3) provides detailed instructions for selecting the proper curve number.

Hydrographs computed by this procedure compared closely with measured hydrographs from 34 watersheds located in Texas, Oklahoma, Arkansas, Louisiana, Mississippi, and Tennessee. The watershed areas ranged from 0.5 to 25 square miles.

Flood Routing

Streams and valleys

The variable storage coefficient (VSC) flood-routing method (5) was selected for HYMO.

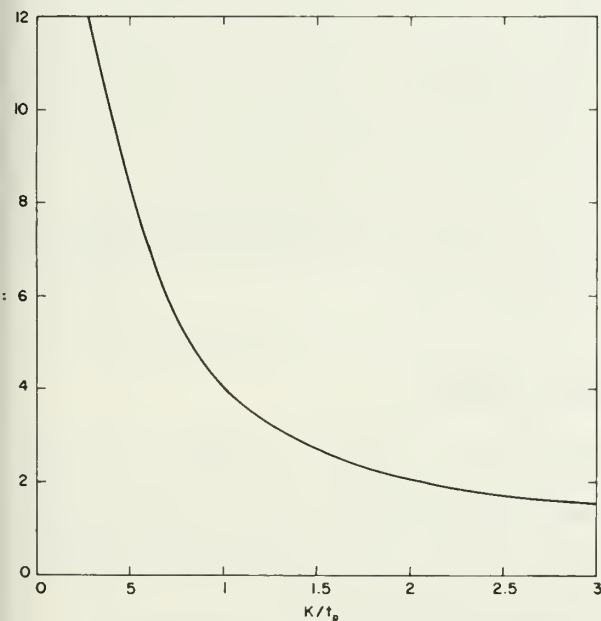


Figure 2. Relationship between dimensionless shape parameter and recession constant/time to peak.

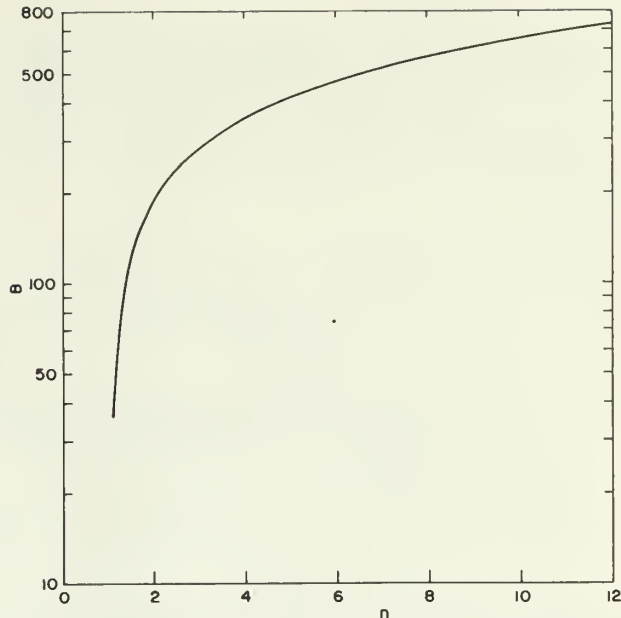


Figure 3. Relationship between dimensionless shape parameter n and watershed parameter B .

The VSC method has been revised (6) to account for the variation in water surface slope during a flood. The revised VSC method is about as accurate as the implicit method (1) and has the general applicability of simpler storage methods. Although an iterative solution is used, the VSC method requires little computer time and is free of convergence problems.

The VSC routing equations are

$$O_2 = C_2 \left[I_a + \left(\frac{1}{C_1} - 1 \right) O_1 \right] \quad (7)$$

$$C_2 = \frac{2 \Delta t}{2T_2 + \Delta t} \quad (8)$$

$$C_1 = \frac{2 \Delta t}{2T_1 + \Delta t} \quad (9)$$

$$T_1 = \left(\frac{L}{1800(V_{I1} + V_{O1})} \right) \times \left(\frac{L \times SLP_0}{L \times SLP_0 + D_{I1} - D_{O1}} \right)^{1/2} \quad (10)$$

$$T_2 = \left(\frac{L}{1800(V_{I2} + V_{O2})} \right) \times \left(\frac{L \times SLP_0}{L \times SLP_0 + D_{I2} - D_{O2}} \right)^{1/2} \quad (11)$$

In these equations subscripts 1 and 2 refer to the beginning and end of the time interval Δt ; the units are cubic feet per second for flow, hours for time, feet per second for velocity, and feet for length and depth. The symbols are defined as follows:

- I = inflow rate.
- O = outflow rate.
- $I_a = \frac{I_1 + I_2}{2}$ = average inflow rate.
- C = storage coefficient.
- T = travel time through the reach.
- L = reach length.
- V = velocity.
- SLP_0 = normal slope.
- D = depth.

Since T_2 and C_2 are dependent upon O_2 , an iterative technique is required to solve the routing equations. In equation 7, I_a and O_1 are known, and C_1 can be computed from equation 9. This leaves only O_2 and C_2 as unknowns. O_1 can be used as a first approximation of O_2 . The normal depth and velocity for the approximate value of O_2 are entered into equation 11 for computing T_2 . Then equation 8 is used to compute C_2 . The second approximation of O_2 is then obtained from equation 7. This iterative process continues until the difference between successive O_2 values is acceptable. HYMO is set to accept differences of 0.1 percent or less. Usually about four iterations are required.

Reservoirs

HYMO uses the storage-indication method (3) to route floods through reservoirs. This method has been widely used and accepted because it is practical and accurate. The SCS National Engineering Handbook gives detailed instructions for using the method.

RULES FOR USING HYMO

The reader should refer to the table, "Example Input for HYMO Commands," as he follows the narrative description of the rules. The example HYMO program that is presented near the end of the manual may also be helpful.

General Rules

HYMO commands are expressed in the first 20 columns of the data card, and columns 21

Rating Curves

Rating curves must be available at enough locations along a valley to adequately describe the hydraulics of the stream and valley. Most of these rating curves must be computed because there are never enough measured rating curves.

HYMO uses Manning's equation to compute the normal flow-rating curves that are used in the VSC flood-routing method. The normal flood-plain slope is determined for each valley section by plotting a profile of the flood plain. The normal channel slope is determined by plotting a profile of the flood plain with channel distances.

Sediment Yields

The universal soil loss equation (8) was modified to compute the sediment yield for individual storms on watersheds. The modified equation is

$$S = 95 (q_p \times Q)^{0.56} \times K \times C \times P \times LS, \quad (12)$$

where S = sediment yield in tons,
 q_p = peak flow rate in cubic feet per second,
 Q = volume of runoff in acre-feet,
 K = the soil-erodibility factor,
 C = the cropping-management factor,
 P = the erosion control practice factor,
 and LS = the slope length and gradient factor.

Detailed instructions for determining K , C , P , and LS are given by Wischmeier and Smith (8).

Since equation 12 was designed to compute sediment yield from watersheds, a delivery ratio is not needed. The delivery ratio is built into equation 12 by including the peak flow rate. Many of the watershed characteristics that influence the peak flow rate also affect the delivery ratio. Equation 12 has performed well under limited testing, but future refinements are expected.

through 79 are used for numeric data and keywords. Column 80 is reserved for a page-change code (an asterisk in column 80 causes the card to be printed on a new page). Continuation cards are allowed when 59 characters are insufficient to express the data.

The data can be written in any format, but at least one blank space must be left between data items. A decimal is required for numbers con-

taining fractions, but not for whole numbers. Keywords can be written with the data to describe individual data items. Comment cards

may be used at any point in a HYMO program by punching an asterisk in column 1 and the comment in columns 2 through 79.

Example input for HYMO commands

Command	Required input
START	RAINFALL BEGINS AT 12.5 HRS PUNCH CODE=1
STORE HYD	ID=1 HYD NO=301 DT=.2 HR DA=1.5 SQ MI FLOW RATES= 0 10 50 100 500 1000 1800 2000 1900 1500 1200 1000 800 600 500 400 300 200 100 50 10 1
COMPUTE HYD	ID=2 HYD NO=302 DT=.5 HR DA=2.1 SQ MI CN=90 HT=100 FT L=3.3 MI MASS RAINFALL = 0 .31 .61 1.04 1.84 2.74 3.06 3.45 4.33 4.75
PRINT HYD	ID=2 CODE=1
PUNCH HYD	ID=2
PLOT HYD	ID I=3 ID II=4
ADD HYD	ID=4 HYD NO=101 ID I=5 ID II=6
STORE RATING CURVE	ID=2 VS NO=15 ELEV AREA FLOW 496.6 0 0 497 2 1 498 9 19 499 19 52 500 30 98
COMPUTE RATING CURVE	ID=1 VS NO=10 NO SEGS=3 MIN ELEV=482 FT MAX ELEV=492 FT CH SLP=.006 FP SLP=.0075 N=.05 DIST=175 FT N=.03 DIST=205 FT N=.05 DIST=450 FT DIST ELEV DIST ELEV DIST ELEV DIST ELEV 0 492.0 100 490.0 175 484.0 188 482.0 190 482.0 205 484.0 250 486.0 275 488.0 310 490.0 450 492.0
COMPUTE TRAVEL TIME	ID=3 REACH NO=8 NO VS=5 L=4500 FT SLP=.0075
ROUTE	ID=3 HYD NO=8 INFLOW ID=6 DT=.25 HR
ROUTE RESERVOIR	ID=5 HYD NO=501 INFLOW ID=1 OUTFLOW (CFS) STORAGE (AC FT) 0 0 22 533 200 555 1000 601 2000 648 3000 694
ERROR ANALYSIS	ID I=3 ID II=5
SEDIMENT YIELD	ID=5 SOIL=.34 CROP=.5 EP=.6 LS=.3
FINISH	

Six hydrographs can be stored in a HYMO program at a time. The hydrographs are identified by storage location numbers 1 through 6. Therefore, the same storage location number must be used for many hydrographs in a HYMO program. This is especially true when routing is done through large watersheds. However, no more than six hydrographs are ever needed at one time because HYMO programs begin at the head of a watershed and work downstream through one reach at a time. When a storage location number is used to store or compute another hydrograph, the first hydrograph is lost. The user should be sure that the hydrograph will not be referred to again before using the storage location number for another command.

To store, compute, or route a hydrograph, the user must specify the time increment. There are no rigid rules about selecting the time increment, but generally it should not be greater than one-fifth of the time to the peak of the hydrograph. This rule usually provides enough points to adequately define the hydrograph. All hydrographs are limited to 300 points.

For the commands "STORE HYD," "COMPUTE HYD," "ADD HYD," "ROUTE," and "ROUTE RESERVOIR," the user must specify the number of the outflow hydrograph. The hydrograph identification numbers are used to designate specific routing reaches, incremental areas, reservoirs, and partial hydrographs. The partial hydrograph number is given to all hydrographs other than outflow hydrographs from reaches, incremental areas, or reservoirs. The identification numbers for each group are

Reaches	1-100
Partial hydrographs	101-300
Incremental areas	301-500
Reservoirs	501+

Command Rules

The first command for any watershed is START. The two data items associated with this command are the time rainfall begins on the watershed and a code for punching output data. If a storm is to be routed through a watershed only once, the punch code is deleted. However, if more than one routing is to be performed, set the punch code equal to a positive number, and the output data for the first routing will be

punched for use in the second routing. More than one routing is usually required.

Two commands, RECALL HYD and STORE TRAVEL TIME, were designed to be computer punched for second routings; consequently, these commands do not appear in the table.

The STORE HYD command is used to store the coordinates of a hydrograph in the computer. It can be used for storing measured hydrographs or hydrographs computed by methods other than the one used in HYMO. The input data required for STORE HYD are storage location number, hydrograph identification number, time increment, watershed area, and flow rates of the hydrograph at the specified time increment.

The COMPUTE HYD command is used to compute hydrographs from the incremental areas of the watershed. The first five items of data are storage location number, hydrograph identification number, time increment, watershed area, and SCS runoff curve number (3). Normally, data items 6 and 7 are watershed height and main stem length. The height and length are used to compute the recession constant K and the time to peak t_p . However, if K and t_p are known or estimated by some other method, they can be entered directly into the program. This is accomplished by placing a minus sign before the values of K and t_p and entering them as data items 6 and 7, respectively. The remaining data items are values of the mass rainfall at the specified time increment.

Since most watersheds have a limited number of rain gages, the same mass rainfall data may be used to develop several hydrographs. Once the mass rainfall data have been entered in a COMPUTE HYD command, they can be repeated for any number of COMPUTE HYD commands without repunching the data. Instead, punch a negative number for the eighth data item of all COMPUTE HYD commands that use the same rain gage. When data from another rain gage are entered, the data from the first rain gage are lost and cannot be recalled by using the negative number code.

The RECALL HYD command is one of the two commands that are computer punched. When the punch code is a positive number, the output from STORE HYD and COMPUTE HYD are punched on cards with the RECALL HYD command. The RECALL HYD command stores

the computed and stored hydrographs on cards; it is therefore not necessary to recompute hydrographs for future routings. Instead, the previously computed hydrographs are read into the program, thus saving considerable computer time.

Although the input data for the RECALL HYD command are never punched manually, a list of the data items may be helpful in checking computer-punched cards. The input data are storage location number, hydrograph identification number, time increment, drainage area, peak flow rate, runoff volume, number of hydrograph points, and flow rates of the hydrograph.

The PRINT HYD command is used to print coordinates of a hydrograph, volume of runoff, and peak flow rate. The required input data are the storage location number and a peak-volume code. The peak-volume code is deleted if a complete hydrograph printout is desired. If a printout of only the runoff volume and the peak flow rate is needed, the peak-volume code is set to a positive value.

The PUNCH HYD command is used to punch any hydrograph in a HYMO program in the proper form for the RECALL HYD command. PUNCH HYD has two purposes: (1) If the punch code is not used, PUNCH HYD can be used to punch one or more hydrographs for future use; and (2) if it is desirable to punch outflow hydrographs associated with ROUTE, ROUTE RESERVOIR, or ADD HYD, PUNCH HYD must be used because the punch code only provides for punching hydrographs associated with STORE HYD and COMPUTE HYD. The only datum required for PUNCH HYD is the storage location number of the hydrograph to be punched.

The PLOT HYD command is used to plot hydrographs in a HYMO program. It will plot one hydrograph on a set of axes, or if a comparison is desired, it will plot two hydrographs on the same set of axes. The required input data are the storage location numbers of the hydrographs to be plotted.

The ADD HYD command adds the coordinates of any two hydrographs. The hydrographs are added at a time increment equal to that of the hydrograph with the shorter time increment. The only data required are the storage location number and hydrograph identification number

of the added hydrograph and the storage location numbers of the two hydrographs to be added.

The STORE RATING CURVE command is used to store rating curves that have been measured or computed previously. STORE RATING CURVE will save considerable computer time if measured or computed rating curves are available. The input data are the storage location number, valley section number, and individual rating curve points described by elevation, end-area, and flow rate. The number of points used to describe a rating curve is limited to 20.

The COMPUTE RATING CURVE command is used to compute the stage-area-flow relationship for a valley section. The input data are storage location number, valley section number, number of segments in the valley section, minimum elevation, maximum elevation, channel and flood-plain slopes, Manning's n value and segment boundary point for each segment, and horizontal and vertical position of points describing the valley section.

The storage location numbers of the valley sections in a particular reach must begin with 1 and increase by one for each valley section in the reach. However, the numbers are assigned without regard to upstream or downstream order. The valley section identification number can be any number from 0.1 to 999.9. These rules concerning storage location and valley section identification numbers also apply to the STORE RATING CURVE command.

Normally, valley sections are divided into three segments (two flood-plain segments and a channel segment) for computing the rating curve. However, some valley sections may have more than one channel or may have an extreme variation in n values across the flood plain, thus requiring more than three segments. A maximum of six segments is permitted. Manning's n values for each segment are input with segment boundary point (distance from the beginning of the valley section to the end of the segment). Flood-plain n values are positive and channel n values are negative.

Twenty points are used to define a rating curve. The location of the points is determined by dividing the difference between the maximum and minimum elevations into 19 equal increments.

The COMPUTE TRAVEL TIME command is used to compute the normal flow travel time relationship used in ROUTE. The input data are storage location number, reach identification number, number of valley sections in the reach, reach length, and slope. The reach identification number can be any number from 0.1 to 999.9. The maximum number of valley sections per reach is six. The slope can be either the channel or flood-plain slope or a weighted average of the two. If flow is confined to the channel, the channel slope is of course applicable. If most of the flow is in the flood plain, usually the flood-plain slope is used. However, a weighted slope based on the relative rates of flow in the channel and the flood plain may be used.

The COMPUTE TRAVEL TIME command considers each rating curve in the reach in computing the travel time flow relationship. COMPUTE TRAVEL TIME automatically selects the flow rates that are used in computing individual travel times. The flow rates of the rating curve with the lowest maximum flow rate are chosen. If the flow rates of any other rating curve in the reach were chosen, the rating curve with the lowest maximum flow rate would have to be extrapolated. The travel time table is limited to 19 points because of the 20-point limit for rating curves.

The STORE TRAVEL TIME command is one of the two computer-punched commands. When the punch code is a positive number, the output from COMPUTE TRAVEL TIME is punched on cards with the STORE TRAVEL TIME command. Therefore, it is not necessary to recompute rating curves or travel time for future routings. Instead, STORE TRAVEL TIME reads the previously computed travel time flow relationship into the program, thus saving considerable computer time.

The input data for STORE TRAVEL TIME are not punched manually, but a list of data items may be helpful in checking computer-punched cards. The input data are storage location number, reach identification number,

reach length, slope, and individual points of the relationship defined by depth, flow, and travel time.

The ROUTE command is used to route floods through streams and valleys. The input data are storage location number and hydrograph identification number of the outflow hydrograph, storage location number of the inflow hydrograph, and time increment. The storage location number of the outflow hydrograph must be the same as the storage location number used in COMPUTE TRAVEL TIME for the reach. To prevent unnecessary program stoppage, ROUTE extrapolates the travel-time table when it is exceeded and writes the message, "TRAVEL TIME TABLE EXCEEDED."

The ROUTE RESERVOIR command is used to route floods through reservoirs. The input data are storage location number and hydrograph identification number of the outflow hydrograph, storage location number of the inflow hydrograph, and individual points of the reservoir's outflow-storage relationship. The outflow-storage relationship must be expressed in 20 points or less. If the outflow-storage relationship is exceeded, ROUTE RESERVOIR will extrapolate the relationship and write the message, "STORAGE-DISCHARGE TABLE EXCEEDED."

The ERROR ANALYSIS command is used to determine the error standard deviation and the percentage error in peak flow between any two hydrographs in a HYMO program. These functions make ERROR ANALYSIS useful in research. The input data are the storage location numbers of the two hydrographs to be analyzed.

The SEDIMENT YIELD command is used to compute the sediment yield at any point in a watershed. Input data required are storage location number of the hydrograph from the area, a soils factor, a crop factor, a slope length and gradient factor, and a conservation practice factor (8).

The FINISH command is used to end HYMO programs. There are no data associated with FINISH.

EXAMPLE HYMO PROGRAM

A short example problem is presented to demonstrate HYMO. Figure 4 is a map of the 6.84-square-mile Brushy Creek watershed near

Riesel, Tex. A flood will be routed through the watershed in its present condition, and the routed outflow hydrograph will be compared to

the hydrograph measured at gaging station G. Also the sediment yield will be predicted and compared with the measured sediment yield. Then the same flood will be routed through the watershed with two proposed reservoirs. To determine the effects of the reservoirs, the outflow hydrograph and sediment yield will be compared to the outflow hydrograph and sediment yield of the present-condition routing.

Comment cards and keywords are used liberally in the example problem to acquaint the user with HYMO. After becoming familiar with HYMO, the user may write fewer comments and keywords, but generally users find them both quite helpful in describing the problem. To save space in the example problem, few of the hydrographs are printed or plotted. Some users may choose to print and plot all hydrographs.

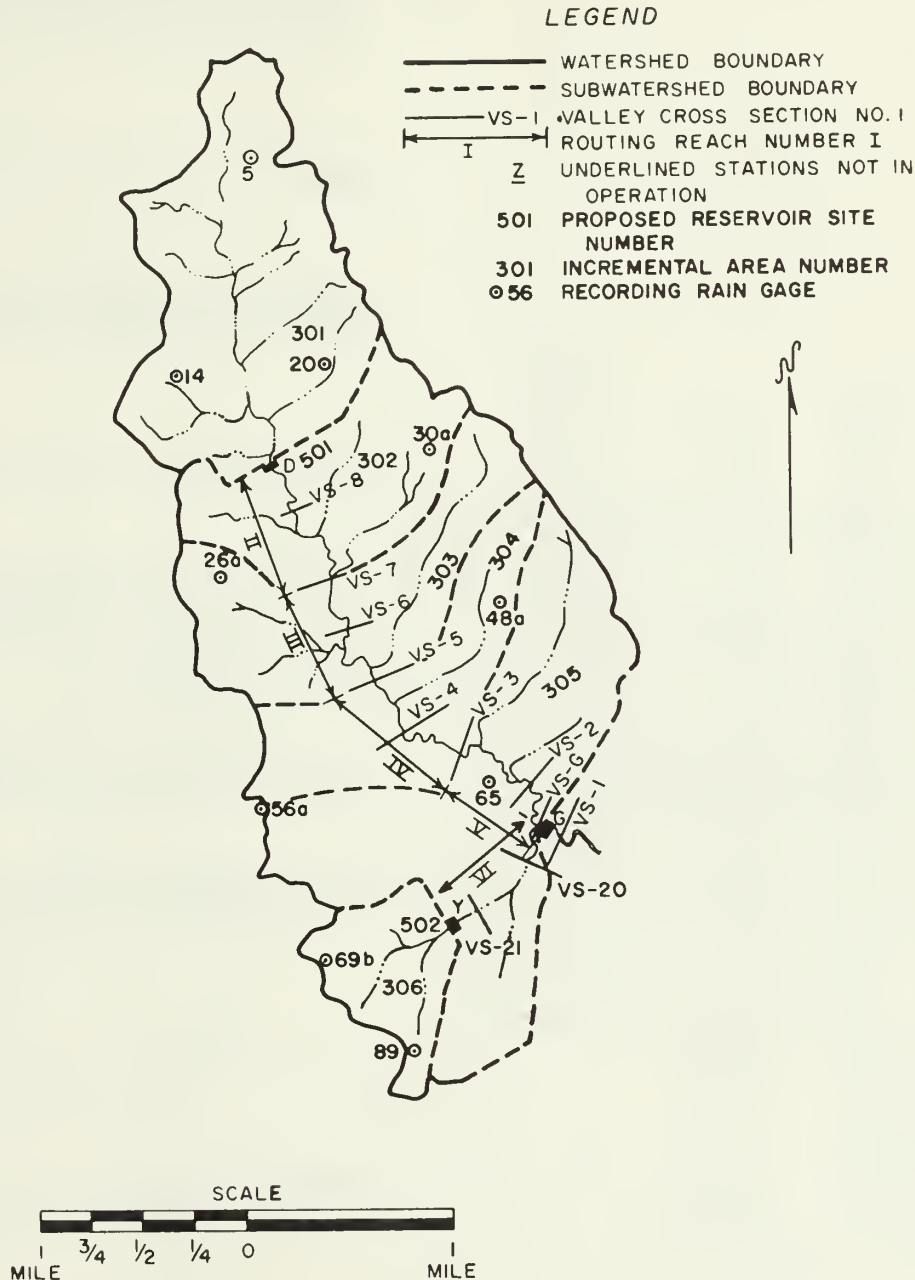


Figure 4. Brushy Creek watershed near Riesel, Tex.

EXAMPLE HYMO PROGRAM

* TO PRINT ON A NEW PAGE AN ASTERISK IS PUNCHED IN COLUMN 80.
 * COMMENTS ARE WRITTEN AT ANY POINT IN A HYMO PROGRAM BY PUNCHING AN
 * ASTERISK IN COLUMN 1 AND THE COMMENT IN COLUMNS 2 - 79.
 * THE FLOOD OF MARCH 29, 1965 WILL BE ROUTED THROUGH THE BRUSHY CREEK WATERSHED
 * NEAR RIESEL, TEXAS.
 * THE START COMMAND IS USED AT THE BEGINNING OF ALL HYMO PROGRAMS TO SET THE
 * TIME RAINFALL BEGINS ON THE WATERSHED, AND TO INDICATE THE PUNCH CODE. THE
 * PUNCH CODE IS USED TO PUNCH THE OUTPUT FOR USE IN FUTURE ROUTINGS. IF ONLY
 * ONE ROUTING IS PLANNED, THE PUNCH CODE IS DELETED.

* START

RAINFALL BEGINS AT 12.5 HRS PUNCH CODE=1

* BEGINNING AT THE TOP OF THE WATERSHED THE FIRST STEP IS TO DETERMINE THE
 * HYDROGRAPH FROM AREA 301. IT IS NOT NECESSARY TO COMPUTE THE HYDROGRAPH,
 * BECAUSE IT WAS MEASURED PREVIOUSLY. THE STORE HYDROGRAPH IS USED TO STORE
 * THE MEASURED HYDROGRAPH IN THE PROGRAM.

* STORE HYD

IO=1 HYD NO=301 OT=1.666667 HRS OA=1.734 SQ MI
 REMAINING DATA ARE FLOW RATES BEGINNING AT
 START TIME AND INCREMENTED BY 0 0 0 0 0
 20 90 220 1025 1420 1380 2085 2260 2360 2110 1885 1890 1760
 1560 1350 1150 1000 860 690 560 400 370 365 380 400 415
 395 370 330 300 270 235 200 175 160 140 130 120 110 110
 110 110 100 100 90 80 70 65 60 50 47 44 41 38 35 33 31 29
 27 25 23 22 20 18 17 16 15 14 13 12 11 10 9 8 7 6
 6 6 5 5 4 4 4 4 3 3 3 2 2 2 1

* THE PRINT HYDROGRAPH IS USED TO PRINT THE HYDROGRAPH FROM AREA 301.
 PRINT HYD
 IO=1

HYDROGRAPH FROM AREA 301

TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS
12.500	0.	16.000	1150.	19.500	140.	23.000	33.
12.667	0.	16.167	1000.	19.666	130.	23.166	31.
12.833	0.	16.333	860.	19.833	120.	23.333	29.
13.000	0.	16.500	690.	20.000	110.	23.500	27.
13.167	0.	16.667	560.	20.166	110.	23.666	25.
13.333	0.	16.833	460.	20.333	110.	23.833	23.
13.500	20.	17.000	400.	20.500	110.	23.999	22.
13.667	90.	17.167	370.	20.666	110.	24.166	20.
13.833	220.	17.333	365.	20.833	100.	24.333	18.
14.000	1025.	17.500	380.	21.000	100.	24.499	17.
14.167	1420.	17.667	400.	21.166	90.	24.666	16.
14.333	1380.	17.833	415.	21.333	80.	24.833	15.
14.500	2085.	18.000	395.	21.500	70.	24.999	14.
14.667	2260.	18.167	370.	21.666	65.	25.166	13.
14.833	2360.	18.333	330.	21.833	60.	25.333	12.
15.000	2110.	18.500	300.	22.000	50.	25.499	11.
15.167	1885.	18.666	270.	22.166	47.	25.666	10.
15.333	1890.	18.833	235.	22.333	44.	25.833	9.
15.500	1760.	19.000	200.	22.500	41.	25.999	8.
15.667	1560.	19.166	175.	22.666	38.	26.166	7.
15.833	1350.	19.333	160.	22.833	35.	26.333	6.
							5.
							4.
							3.
							2.
							1.

RUNOFF VOLUME = 4.933 INCHES
 PEAK DISCHARGE RATE = 2360.0 CFS

* THE HYDROGRAPH FROM AREA 301 IS ROUTED THROUGH REACH 2. THE FIRST STEP IS TO *
 * COMPUTE RATING CURVES FOR VALLEY SECTIONS 7 AND 8.
 *

COMPUTE RATING CURVE IO=1 VS 8 3 SEGMENTS MIN ELEV = 513.8 FT
 MAX ELEV = 521 FT CH SLOPE = .0026 FP SLOPE = .0033

FIRST SEG .05 414
 SECOND SEG -.03 423
 THIRD SEG .05 602

THE REMAINING DATA DEFINE THE VALLEY CROSS SECTION

DISTANCE	ELEV
10	521
18	518.2
30	519.1
150	518.5
200	518.1
325	517.9
345	516.1
357	516.0
370	517.1
390	516.8
414	514.7
416	513.8
419	513.8
423	515.3
450	514.7
464	516.9
474	516.8
483	514.8
492	516.4
550	518.1
600	520.8
602	521.3

RATING CURVE VALLEY SECTION 8.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
513.80	0.0	0.0
514.18	1.5	1.7
514.56	3.7	6.3
514.94	8.4	15.5
515.32	23.0	37.8
515.69	44.7	85.8
516.07	70.9	153.2
516.45	107.1	252.0
516.83	153.3	370.7
517.21	217.8	545.3
517.59	291.9	810.0
517.97	373.9	1064.2
518.35	505.3	1430.5
518.73	665.6	1979.6
519.10	858.7	2671.5
519.48	1069.9	3670.5
519.86	1284.1	4853.4
520.24	1501.3	6225.1
520.62	1721.7	7793.4
521.00	1944.8	9613.0

COMPUTE RATING CURVE ID=2 VS 7 3 SEGMENTS MIN ELEV=506.9 FT
 MAX ELEV=515 FT CH SLOPE=.0018 FP SLOPE=.00245
 N=.05 DIST=636 N=-.03 DIST=657 N=.05 DIST=2000
 DIST ELEV DIST ELEV DIST ELEV DIST ELEV
 0 515.0 100 514.0 600 510.6 636 511.3
 390 513.6 550 512.0 657 510.8 748 510.4
 641 506.9 647 506.9 850 511.7 1050 512.7
 772 512.5 800 511.7 1800 514 2000 515
 1200 513.1 1255 513.6

RATING CURVE VALLEY SECTION 7.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
506.90	0.0	0.0
507.33	2.9	3.2
507.75	6.5	11.0
508.18	10.7	23.3
508.60	15.6	40.5
509.03	21.2	63.3
509.46	27.4	92.1
509.88	34.4	127.9
510.31	42.0	171.2
510.74	64.6	229.2
511.16	127.4	357.5
511.59	206.5	570.7
512.02	322.2	806.6
512.44	499.4	1204.4
512.87	739.0	1780.5
513.29	1054.1	2632.7
513.72	1428.1	3458.4
514.15	2074.3	4671.2
514.57	2845.0	7184.3
515.00	3670.1	10314.2

* BEFORE ROUTING THE TRAVEL TIME - DEPTH - FLOW RELATIONSHIP MUST BE COMPUTED *

* FOR THE REACH.

* COMPUTE TRAVEL TIME ID=2 REACH 2 2 VALLEY SECTIONS
REACH LENGTH=3400 FT SLOPE=.0029

TRAVEL TIME TABLE
REACH 2.0

WATER DEPTH FEET	FLOW RATE CFS	TRAVEL TIME HRS
0.30	2.	0.8317
0.68	6.	0.5966
1.07	16.	0.4981
1.58	38.	0.4721
2.18	86.	0.3899
2.75	153.	0.3381
3.28	252.	0.3426
3.66	371.	0.3637
4.02	545.	0.3593
4.45	810.	0.3589
4.78	1064.	0.3598
5.13	1431.	0.3627
5.50	1980.	0.3526
5.86	2672.	0.3412
6.29	3670.	0.3359
6.67	4853.	0.3322
6.98	6225.	0.3074
7.29	7793.	0.2864
7.60	9613.	0.2667

* TO OBTAIN THE OUTFLOW HYD FROM REACH 2 THE HYD FROM AREA 302 MUST BE COMPUTED*
* AND ADDED TO THE ROUTED HYD 101.

COMPUTE HYD

ID=1 HYD NO=302 DT=.1666667 HR DA=.837 SQ MI
CN=82 HEIGHT=69 FT LENGTH=1.33 MI
REMAINING DATA DEFINE MASS RAINFALL FROM
START TIME TO END IN INCREMENTS OF DT 0 0 .18 .46 .57 .65
.89 1.45 2.05 2.7 3.15 3.5 4 4.49 4.72 4.78 4.92 5 5.06
5.06 5.06 5.06 5.11 5.2 5.3 5.31 5.31 5.32 5.34 5.43
5.59 5.84 5.85 5.86 5.86 5.86 5.87 5.87 5.88 5.88
5.88 5.92 6.09 6.11 6.13 6.15 6.16 6.16 6.17 6.18 6.18
6.19

SHAPE CONSTANT, N = 2.208
UNIT PEAK = 227.0CFS

PRINT HYD

ID=1

HYDROGRAPH FROM AREA 302

TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS
12.500	0.	17.667	193.	22.833	53.	27.999	12.	33.166	1.	33.166	1.
12.667	0.	17.833	211.	23.000	49.	28.166	11.	33.332	1.	33.332	1.
12.833	0.	18.000	219.	23.166	46.	28.333	11.	33.499	1.	33.499	1.
13.000	0.	18.167	219.	23.333	43.	28.499	10.	33.666	1.	33.666	1.
13.167	1.	18.333	212.	23.500	40.	28.666	10.	33.832	1.	33.832	1.
13.333	2.	18.500	201.	23.666	37.	28.833	9.	33.999	1.	33.999	1.
13.500	9.	18.666	188.	23.833	35.	28.999	9.	34.166	1.	34.166	1.
13.667	36.	18.833	174.	23.999	33.	29.166	9.	34.332	1.	34.332	1.
13.833	89.	19.000	160.	24.166	32.	29.333	8.	34.499	1.	34.499	1.
14.000	169.	19.166	147.	24.333	30.	29.499	8.	34.666	0.	34.666	0.
14.167	254.	19.333	135.	24.499	29.	29.666	8.	34.832	0.	34.832	0.
14.333	332.	19.500	125.	24.666	27.	29.832	7.	34.999	0.	34.999	0.
14.500	411.	19.666	115.	24.833	26.	29.999	7.	35.165	0.	35.165	0.
14.667	491.	19.833	109.	24.999	25.	30.166	6.	35.332	0.	35.332	0.
14.833	548.	20.000	117.	25.166	24.	30.332	6.	35.499	0.	35.499	0.
15.000	570.	20.166	124.	25.333	23.	30.499	5.	35.665	0.	35.665	0.
15.167	572.	20.333	127.	25.499	22.	30.666	5.	35.832	0.	35.832	0.
15.333	558.	20.500	128.	25.666	21.	30.832	4.	35.999	0.	35.999	0.
15.500	532.	20.666	125.	25.833	20.	30.999	4.	36.165	0.	36.165	0.
15.667	495.	20.833	120.	25.999	19.	31.166	3.	36.332	0.	36.332	0.
15.833	451.	21.000	113.	26.166	19.	31.332	3.	36.499	0.	36.499	0.
16.000	407.	21.166	106.	26.333	18.	31.499	3.	36.665	0.	36.665	0.
16.167	363.	21.333	99.	26.499	17.	31.666	2.	36.832	0.	36.832	0.
16.333	326.	21.500	92.	26.666	16.	31.832	2.	36.999	0.	36.999	0.
16.500	300.	21.666	86.	26.833	16.	31.999	2.	37.165	0.	37.165	0.
16.667	282.	21.833	81.	26.999	15.	32.166	2.	37.332	0.	37.332	0.
16.833	264.	22.000	75.	27.166	14.	32.332	2.	37.499	0.	37.499	0.
17.000	244.	22.166	70.	27.333	14.	32.499	2.	37.665	0.	37.665	0.
17.167	223.	22.333	65.	27.499	13.	32.666	2.	37.832	0.	37.832	0.
17.333	204.	22.500	61.	27.666	13.	32.832	2.	37.999	0.	37.999	0.
17.500	193.	22.666	57.	27.833	12.	32.999	2.				

RUNOFF VOLUME = 4.124 INCHES
PEAK DISCHARGE RATE = 572.0 CFS

HYD NO=2

IDS OF HYDS TO 8E ADDED ARE 1 AND 2

#

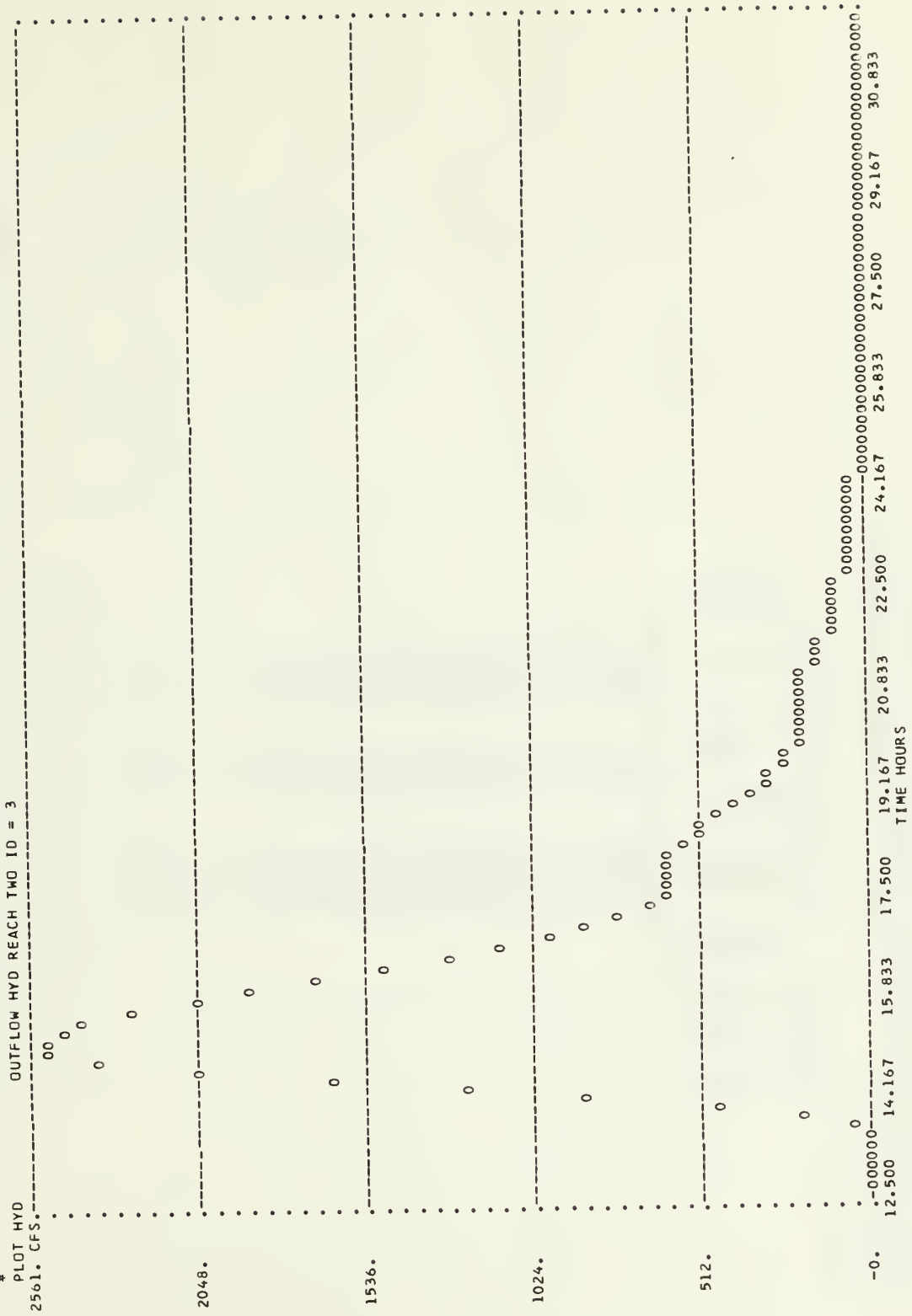
OUTFLOW HYDROGRAPH REACH 2

[illegible]

RUNOFF VOLUME = 4.674 INCHES
PEAK DISCHARGE RATE = 2560.5 CFS

* IT MAY BE DESIRABLE TO PLOT ALL HYDROGRAPHS. HOWEVER TO SAVE SPACE IN THIS *
 * EXAMPLE, ONLY A FEW OUTFLOW HYDROGRAPHS ARE PLOTTED.

* PLOT HYD OUTFLOW HYD REACH TWO ID = 3



* THIS COMPLETES THE ROUTING THROUGH THE FIRST REACH. FOR THE REMAINDER OF THE *
 ** ROUTING, COMMENTS AND KEYWORDS WILL BE BRIEFER.
 ** VALLEY SECTIONS 5 6 AND 7 ARE USED TO ROUTE THROUGH REACH 3. THE RATING CURVE
 ** HAS BEEN COMPUTED FOR VS 7 AND IS STORED IN ID 2. ID NUMBERS 1 AND 3 MUST BE
 ** USED FOR VS-5 AND VS-6.
 *

COMPUTE RATING CURVE ID=1 VS 6 3 SEG MIN ELEV=502.1 FT
 MAX ELEV=511.0 FT CH SLP=.0018 FP SLP=.00245
 N=.05 DIST=680 N=-.03 DIST=695 N=.05 DIST=1025
 DIST ELEV DIST ELEV DIST ELEV DIST ELEV
 0 511.0 250 508.4 350 507.7 400 507.7
 450 507.9 550 507.8 650 507.9 653 506.6
 680 505.5 684 503.8 687 502.1 693 502.8
 695 504.6 702 503.6 800 505.4 850 507.8
 950 509.8 1025 511.0

RATING CURVE VALLEY SECTION 6.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
502.10	0.0	0.0
502.57	1.1	0.9
503.04	4.3	6.2
503.50	8.3	16.8
503.97	13.0	32.4
504.44	18.4	53.4
504.91	24.8	82.8
505.38	33.3	122.0
505.85	80.8	205.3
506.31	150.3	373.0
506.78	229.4	618.7
507.25	314.4	946.0
507.72	405.6	1303.6
508.19	630.1	1826.8
508.66	925.5	2672.5
509.12	1254.0	3809.6
509.59	1614.6	5249.7
510.06	2007.6	6992.5
510.53	2435.2	9076.7
511.00	2897.5	11559.4

*

COMPUTE RATING CURVE									
ID=3	VS	5	3	SEG	MIN ELEV=496.6				
MAX ELEV=506 FT	CH	SLP=.0018	FP	SLP=.00245					
N=.05	DIST=314	N=-.03	DIST=326	N=.05	DIST=960				
DIST	ELEV	DIST	ELEV	DIST	ELEV	DIST	ELEV	DIST	ELEV
25	506.0	150	503.7	200	502.2	250	501.2		
300	502.5	314	500.5	317	497.5	320	496.6		
325	496.9	326	500.5	334	501.3	350	502.0		
400	503.4	450	503.8	550	503.7	650	504.1		
800	505.4	850	504.5	900	505.4	960	506.0		
RATING CURVE VALLEY SECTION 5.0									
WATER SURFACE		WATER AREA		FLOW		FLOW			
ELEV		SQ	FT	AREA		RATE		CFS	
496.60		0.0		0.0		0.0			
497.09		2.1		2.1		2.1			
497.59		5.9		5.9		9.9			
498.08		10.1		10.1		23.1			
498.58		14.7		14.7		41.0			
499.07		19.6		19.6		63.3			
499.57		24.8		24.8		90.2			
500.06		30.3		30.3		121.8			
500.56		36.1		36.1		159.5			
501.05		44.6		44.6		215.3			
501.55		62.9		62.9		287.4			
502.04		108.9		108.9		403.4			
502.54		184.6		184.6		592.3			
503.03		282.2		282.2		887.2			
503.52		397.5		397.5		1272.9			
504.02		583.1		583.1		1723.6			
504.51		854.7		854.7		2526.8			
505.01		1182.7		1182.7		3561.5			
505.50		1578.6		1578.6		4956.2			
506.00		2022.1		2022.1		6825.7			

COMPUTE TRAVEL TIME ID=1 REACH 3 3 VS LENGTH=3330 FT SLP=.00245 *

TRAVEL TIME TABLE
REACH 3.0

WATER DEPTH FEET	FLOW RATE CFS	TRAVEL TIME HRS
0.45	2.	0.8623
0.96	10.	0.5484
1.45	23.	0.4135
1.92	41.	0.3434
2.37	63.	0.2988
2.80	90.	0.2674
3.22	122.	0.2447
3.58	160.	0.2527
3.99	215.	0.2703
4.32	287.	0.2906
4.69	403.	0.3160
5.10	592.	0.3241
5.57	887.	0.3265
6.03	1273.	0.3205
6.45	1724.	0.3371
6.91	2527.	0.3349
7.40	3561.	0.3331
7.86	4956.	0.3286
8.31	6826.	0.3039

ROUTE ID=1 HYD NO=102 INFLOW ID=3 DT=.2 HR

* IT MAY NOT BE NECESSARY TO PRINT THE COORDINATES OF ALL HYDS. FOR THE
* REMAINDER OF THE EXAMPLE, ONLY REACH OUTFLOW HYDS WILL BE PRINTED. TO PRINT
* ONLY THE RUNOFF VOLUME AND PEAK RATE, A CODE IS USED WITH PRINT HYD.

PRINT HYD ID=1 CODE=1

PARTIAL HYDROGRAPH 102

RUNOFF VOLUME = 4.672 INCHES
PEAK DISCHARGE RATE = 2366.2 CFS

* COMPUTE THE HYD FROM AREA 303.

*

COMPUTE HYD ID=2 HYD NO 303 DT=.1666667 HR DA=1.108 SQ MI CN=82
HT=80 FT L=1.7 MI CODE=-1 (SIGNAL TO USE SAME MASS
RAINFALL AS USED IN PREVIOUS HYD)
SHAPE CONSTANT, N = 2.248
UNIT PEAK = 253.1CFS

PRINT HYD ID=2 CODE=1

HYDROGRAPH FROM AREA 303

RUNOFF VOLUME = 4.131 INCHES
PEAK DISCHARGE RATE = 673.5 CFS

OUTFLOW HYDROGRAPH REACH 3

RUNOFF VOLUME = 4.509 INCHES
PEAK DISCHARGE RATE = 3026.6 CFS

*

* ROUTE THROUGH REACH 4.

*

COMPUTE RATING CURVE ID=1 VS=4 3 SEG MIN ELEV 491.8
 MAX ELEV=501 FT CH SLP=.0018 FP SLP=.003
 N=.05 DIST=10% N=-.03 DIST=1068 N=.05 DIST=1082
 DIST ELEV DIST ELEV DIST ELEV DIST ELEV
 0 501.0 200 500.3 250 500.3 300 499.9
 450 499.1 500 500.8 550 498.9 600 499.0
 700 499.5 800 499.6 850 499.0 900 497.7
 950 497.6 1000 497.1 1031 497.4 1046 497.2
 1050 494.5 1056 494.2 1061 491.9 1064 491.8
 1068 495.7 1072 497.4 1082 501.0

RATING CURVE VALLEY SECTION 4.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
491.80	0.0	0.0
492.28	1.6	1.7
492.77	4.1	6.6
493.25	7.3	15.1
493.74	11.2	27.8
494.22	16.0	44.6
494.70	23.3	62.5
495.19	32.0	103.5
495.67	41.2	155.2
496.16	51.2	222.8
496.64	62.1	305.1
497.13	73.9	403.4
497.61	115.2	553.8
498.09	200.0	813.9
498.58	296.4	1195.6
499.06	408.8	1598.0
499.55	612.3	2078.4
500.03	949.7	3122.3
500.51	1350.0	4498.2
501.00	1837.5	6404.5

*

COMPUTE RATING CURVE ID=2 VS=3 3 SEG MIN EVEL=486.2
 MAX ELEV=499 CH SLP=.0C18 FP SLP=.0036
 N=.05 DIST=520 N=.03 DIST=547 N=.05 DIST=1200
 DIST ELEV DIST ELEV DIST ELEV DIST ELEV
 297 499.0 350 496.4 378 494.7 400 491.7
 450 491.8 500 492.2 520 491.2 529 486.6
 536 486.2 540 490.4 547 492.7 600 495.9
 650 496.1 729 496.7 900 496.6 1000 497.0
 1150 498.3 1210 499.0

RATING CURVE VALLEY SECTION 3.0			
WATER SURFACE		FLOW AREA	FLOW RATE
ELEV	SQ FT	AREA	CFS
486.20	0.0	3.6	0.0
486.87	3.6	9.8	4.4
487.55	17.3	26.1	20.6
488.22	36.2	47.6	48.2
488.89	60.7	77.3	88.8
489.57	143.6	247.2	144.3
490.24	360.4	484.4	217.0
490.92	619.5	768.9	300.6
491.59	949.8	1271.9	419.1
492.26	1746.6	2283.0	626.6
492.94	2873.8	3295.3	1054.5
493.61			1720.5
494.28			2616.8
494.96			3756.2
495.63			5163.4
496.30			6844.7
496.98			9049.4
497.65			12457.3
498.32			17061.9
499.00			23295.3

CCOMPUTE TRAVEL TIME ID=1 REACH 4 3 VS L=3415 SLP=.003 *

TRAVEL TIME TABLE
REACH 4.0

WATER DEPTH FEET	FLOW RATE CFS	TRAVEL TIME HRS
0.38	2.	0.8777
0.84	7.	0.6140
1.25	15.	0.4719
1.69	28.	0.3899
2.14	45.	0.3386
2.54	62.	0.3192
3.15	104.	0.2683
3.75	155.	0.2335
4.32	223.	0.2076
4.87	305.	0.2004
5.36	403.	0.2022
5.82	554.	0.2311
6.32	814.	0.2513
6.83	1196.	0.2491
7.28	1598.	0.2532
7.69	2078.	0.2625
8.27	3122.	0.2570
8.86	4498.	0.2458
9.47	6405.	0.2302

ROUTE ID=1 HYD NO=103 INFLOW ID=3 DT=.2
PRINT HYD ID=1 CODE=1

PARTIAL HYDROGRAPH 103

RUNOFF VOLUME = 4.508 INCHES
PEAK DISCHARGE RATE = 2904.3 CFS

* COMPUTE THE HYD FROM AREA 304.

* COMPUTE HYD ID=2 HYD NO=304 DT=.25 DA=.807 CN=82
HT=80 L=1.70
RAINFALL = 0 .45 .59 .87 1.7 2.72 3.35 3.98 4.65 4.8 4.98
5.97 5.07 5.11 5.21 5.34 5.34 5.35 5.45 5.77 5.88 5.95
6.06 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1 6.1
6.13 6.13 6.13 6.14 6.17 6.17 6.17 6.17 6.18 6.18 6.19
SHAPE CONSTANT, N = 2.156
UNIT PEAK = 192.9CFS

PRINT HYD ID=2 CODE=1
HYDROGRAPH FROM AREA 304

RUNOFF VOLUME = 4.111 INCHES
PEAK DISCHARGE RATE = 504.5 CFS

并

✱

COMPUTE RATING CURVE

MAX	ELEV	VS 2	3 SEG	MIN	ELEV=481.8
493	493	CH	SLP=.0018	FP	SLP=.0036
DIST	DIST=387	N=.05	DIST=405	N=.05	DIST=558
ELEV	ELEV	DIST	ELEV	DIST	ELEV
131	493.0	150	492.0	189	490.8
258	489.9	270	486.8	300	485.5
387	485.5	392	485.3	397	482.1
405	485.4	427	488.6	450	490.1
558	493.0			550	492.9

RATING CURVE VALLEY SECTION 2.0

[illegible]

*

COMPUTE RATING CURVE ID=3 VS=1 3 SEG MIN ELEV=474.1 MAX ELEV=488
 CH SLP=.0018 FP SLP=.0028 N=.05 DIST= 232
 N=-.03 DIST= 250 N=.05 DIST= 627

DIST	ELEV	OIST	ELEV	DIST	ELEV	DIST	ELEV
61	488.0	100	486.6	171	481.0	215	480.8
232	478.6	236	474.2	242	474.1	247	477.9
250	478.9	300	482.9	350	484.2	400	484.2
627	488.0						

RATING CURVE VALLEY SECTION 1.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
474.10	0.0	0.0
474.83	4.6	7.0
475.56	10.7	25.4
476.29	18.0	55.1
477.03	26.5	97.4
477.76	36.2	154.2
478.49	47.4	220.9
479.22	62.4	331.5
479.95	87.4	507.9
480.68	123.2	756.2
481.41	192.1	1108.7
482.15	283.5	1659.7
482.88	388.3	2411.3
483.61	513.1	3352.4
484.34	672.5	4507.0
485.07	896.5	6323.3
485.80	1159.2	8782.5
486.53	1460.7	12141.1
487.27	1804.2	16663.6
488.00	2194.6	23601.4

*

COMPUTE TRAVEL TIME ID=1 REACH 5 3 VS L=3310 SLP=.003

TRAVEL TIME TABLE
REACH 5.0

	WATER DEPTH FEET	FLOW RATE CFS	TRAVEL TIME HRS
	0.35	2.	0.7488
	0.96	9.	0.5416
	1.57	26.	0.3996
	2.19	52.	0.3173
	2.82	90.	0.2666
	3.45	141.	0.2309
	4.28	237.	0.2201
	5.30	461.	0.2103
	6.13	818.	0.2078
	6.83	1317.	0.1948
	7.47	1958.	0.1768
	8.09	2750.	0.1607
	8.71	3713.	0.1476
	9.31	4861.	0.1371
	9.78	5880.	0.1319
	10.18	6694.	0.1320
	10.77	8589.	0.1268
	11.33	11067.	0.1204
	11.89	14199.	0.1130
ROUTE ID=1 HYD NO=104	INFLOW ID=3	DT=.2	
PRINT HYD ID=1 CODE=1			

PARTIAL HYDROGRAPH 104

RUNOFF VOLUME = 4.436 INCHES
PEAK DISCHARGE RATE = 3318.5 CFS

COMPUTE HYD	ID=2	HYD NO=305	DT=.333333	DA=1.875	CN=82
	K=-2	TP=-1.2			
	RAINFALL	0 0 .29 .61 1.12 2.27 3.24 4.21 4.76 4.94 5.03			
		5.03 5.07 5.31 5.43 5.44 5.5 5.7 5.71 5.71 5.72 5.72			
		5.73 5.78 5.79 5.8 5.8 5.81 5.83 5.84 5.85 5.85 5.86			
		5.87			
	SHAPE CONSTANT, N =	2.254			
	UNIT PEAK =	334.3CFS			

PRINT HYD ID=2 CODE=1

HYDROGRAPH FROM AREA 305

RUNOFF VOLUME = 3.837 INCHES
PEAK DISCHARGE RATE = 936.7 CFS

*

* ADD THE HYO FROM AREA 305 TO THE PARTIAL HYO 104.

* IO=3 HYO NO=105 IOS ADDED ARE 1 AND 2
AOC HYO IO=3 CODE=1
PRINT HYO

PARTIAL HYDROGRAPH 105

RUNOFF VOLUME = 4.259 INCHES
PEAK DISCHARGE RATE = 4244.3 CFS

* THE HYO FROM AREA 306 WAS MEASURED, SO STORE HYO IS USED TO STORE IT IN THE
* PRCGRAM.

* STORE HYO
IO=1 HYO NO=306 OT=.25 OA=.483
FLOW RATE CFS= 0 0 0 45 280 560 638 570 370 258 170 97 72
64 61 80 70 59 54 52 51 50 46 44 40 38 33 30 27 25 24 23 22
21 20 20 19 18 16 15 13 11 10 9 8 7 6 5 5 4 4 3 3 3 2
2 2 1 1

* ROUTE THE HYO FROM AREA 306 THROUGH REACH 6.

* COMPUTE RATING CURVE IO=1 VS=21 3 SEG MIN ELEV=506.0 MAX ELEV=514
CH SLP= .006 FP SLP= .0075 N=.05 OIST= 300
N=-.03 OIST= 310 N=.05 OIST= 570
OIST ELEV OIST ELEV OIST ELEV OIST ELEV
0 514.0 300 508.0 302 506.0 307 506.0
310 508.0 380 510.0 520 512.0 570 514.0

RATING CURVE VALLEY SECTION 21.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
506.00	0.0	0.0
506.42	2.3	4.7
506.84	5.1	15.7
507.26	8.3	32.6
507.68	12.0	55.7
508.10	16.5	87.5
508.53	32.0	146.0
508.95	62.5	250.6
509.37	108.1	420.9
509.79	168.8	675.2
510.21	245.2	1018.8
510.63	342.2	1482.0
511.05	460.4	2102.0
511.47	599.9	2902.4
511.89	760.6	3907.9
512.31	940.3	5214.1
512.73	1133.7	6796.0
513.16	1340.3	8649.2
513.58	1560.2	10795.8
514.00	1793.3	13260.7

COMPUTE RATING CURVE IO=2 VS=20 3 SEG MIN ELEV=482.0 MAX ELEV=492 *

CH SLP=.006 FP SLP=.0075 N=.05 DIST=175
 N=-.03 DIST=205 N=.05 DIST=450
 OIST ELEV DIST ELEV DIST ELEV OIST ELEV
 0 492.0 100 490.0 175 484.0 188 482.0
 190 482.0 205 484.0 250 486.0 275 488.0
 310 490.0 450 492.0

RATING CURVE VALLEY SECTION 20.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
482.00	0.0	0.0
482.53	3.0	5.5
483.05	9.9	27.8
483.58	20.6	76.1
484.10	35.3	164.8
484.63	57.9	329.7
485.16	90.1	573.6
485.68	132.0	917.0
486.21	183.4	1384.8
486.74	242.3	1999.6
487.26	308.0	2777.3
487.79	380.7	3744.8
488.31	460.5	4921.7
488.84	548.5	6356.6
489.37	644.8	8115.9
489.89	749.5	10274.9
490.42	870.3	12413.3
490.94	1023.7	15306.2
491.47	1210.4	19275.9
492.00	1430.4	24694.0

CCOMPUTE TRAVEL TIME ID=2 REACH 6 2 VS L=4080 SLP=.0075

TRAVEL TIME TABLE
REACH 6.0

WATER DEPTH FEET	FLOW RATE CFS	TRAVEL TIME HRS
0.44	5.	0.5893
0.80	16.	0.4055
1.18	33.	0.3346
1.52	56.	0.2852
1.88	88.	0.2525
2.26	146.	0.2491
2.66	251.	0.2478
3.10	421.	0.2397
3.55	675.	0.2277
4.00	1019.	0.2161
4.46	1482.	0.2045
4.93	2102.	0.1918
5.40	2902.	0.1791
5.88	3908.	0.1671
6.37	5214.	0.1542
6.85	6796.	0.1423
7.33	8649.	0.1318
7.80	10796.	0.1228
8.28	13261.	0.1157

ROUTE ID=2 HYD NU=106 INFLOW ID=1 DT=.2
PRINT HYD CODE=1

PARTIAL HYDROGRAPH 106

RUNOFF VOLUME = 3.364 INCHES
PEAK DISCHARGE RATE = 574.6 CFS

* TO OBTAIN THE OUTFLOW HYD FROM REACH 5, ADD PARTIAL HYDS 106 AND 105.
 *
 * ADD HYD 10=6 HYD NO=5 IDS ADDED ARE 3 AND 2
 * SINCE THE OUTFLOW HYDROGRAPH FROM REACH 5 WILL BE USED FOR COMPARISON IN THE
 * SECOND ROUTING, THE PUNCH HYD COMMAND IS USED. THIS IS NECESSARY BECAUSE THE
 * PUNCH CODE DOES NOT PUNCH FOR THE ADD HYD COMMAND.
 10=6
 10=6
 PRINT HYD

OUTFLOW HYDROGRAPH REACH 5

TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS
12.500	0.	20.300	889.	28.100	103.	35.900	16.	43.700	1.
12.700	0.	20.500	833.	28.300	98.	36.100	15.	43.900	1.
12.900	0.	20.700	788.	28.500	94.	36.300	15.	44.100	1.
13.100	0.	20.900	749.	28.700	89.	36.500	14.	44.300	1.
13.300	3.	21.100	714.	28.900	85.	36.700	13.	44.500	1.
13.500	15.	21.300	678.	29.100	81.	36.900	13.	44.700	1.
13.700	106.	21.500	641.	29.300	78.	37.100	12.	44.900	1.
13.900	378.	21.700	604.	29.500	75.	37.300	12.	45.100	1.
14.100	829.	21.900	568.	29.700	72.	37.500	11.	45.300	0.
14.300	1349.	22.100	532.	29.900	69.	37.700	11.	45.500	0.
14.500	1855.	22.300	497.	30.100	67.	37.900	10.	45.700	0.
14.700	2403.	22.500	466.	30.300	64.	38.100	10.	45.900	0.
14.900	2983.	22.700	436.	30.500	61.	38.300	9.	46.100	0.
15.100	3537.	22.900	407.	30.700	59.	38.500	9.	46.300	0.
15.300	3968.	23.100	379.	30.900	56.	38.700	7.	46.500	0.
15.500	4260.	23.300	354.	31.100	54.	38.900	7.	46.700	0.
15.700	4367.	23.500	331.	31.300	52.	39.100	7.	46.900	0.
15.900	4337.	23.700	312.	31.500	49.	39.300	7.	47.100	0.
16.100	4181.	23.900	294.	31.700	47.	39.500	6.	47.300	0.
16.300	3950.	24.100	279.	31.900	45.	39.700	6.	47.500	0.
16.500	3684.	24.300	265.	32.100	42.	39.900	6.	47.700	0.
16.700	3415.	24.500	251.	32.300	40.	40.100	6.	47.900	0.
16.900	3143.	24.700	237.	32.500	38.	40.300	6.	48.100	0.
17.100	2880.	24.900	223.	32.700	36.	40.500	5.	48.299	0.
17.300	2611.	25.100	211.	32.900	35.	40.700	5.	48.499	0.
17.500	2353.	25.300	200.	33.100	33.	40.900	5.	48.699	0.
17.700	2137.	25.500	190.	33.300	31.	41.100	5.	48.899	0.
17.900	1978.	25.700	181.	33.500	30.	41.300	4.	49.099	0.
18.100	1869.	25.900	172.	33.700	29.	41.500	4.	49.299	0.
18.300	1783.	26.100	164.	33.900	28.	41.700	3.	49.499	0.
18.500	1707.	26.300	156.	34.100	26.	41.900	3.	49.699	0.
18.700	1628.	26.500	148.	34.300	25.	42.100	2.	49.899	0.
18.900	1541.	26.700	141.	34.500	24.	42.300	2.	50.099	0.
19.100	1446.	26.900	135.	34.700	22.	42.500	1.	50.299	0.
19.300	1347.	27.100	129.	34.900	21.	42.700	1.	50.499	0.
19.500	1244.	27.300	123.	35.100	20.	42.900	1.	50.699	0.
19.700	1141.	27.500	118.	35.300	19.	43.100	1.	50.899	0.
19.900	1044.	27.700	112.	35.500	18.	43.300	1.	51.099	0.
20.100	959.	27.900	107.	35.700	17.	43.500	1.		

RUNOFF VOLUME = 4.196 INCHES
 PEAK DISCHARGE RATE = 4367.5 CFS

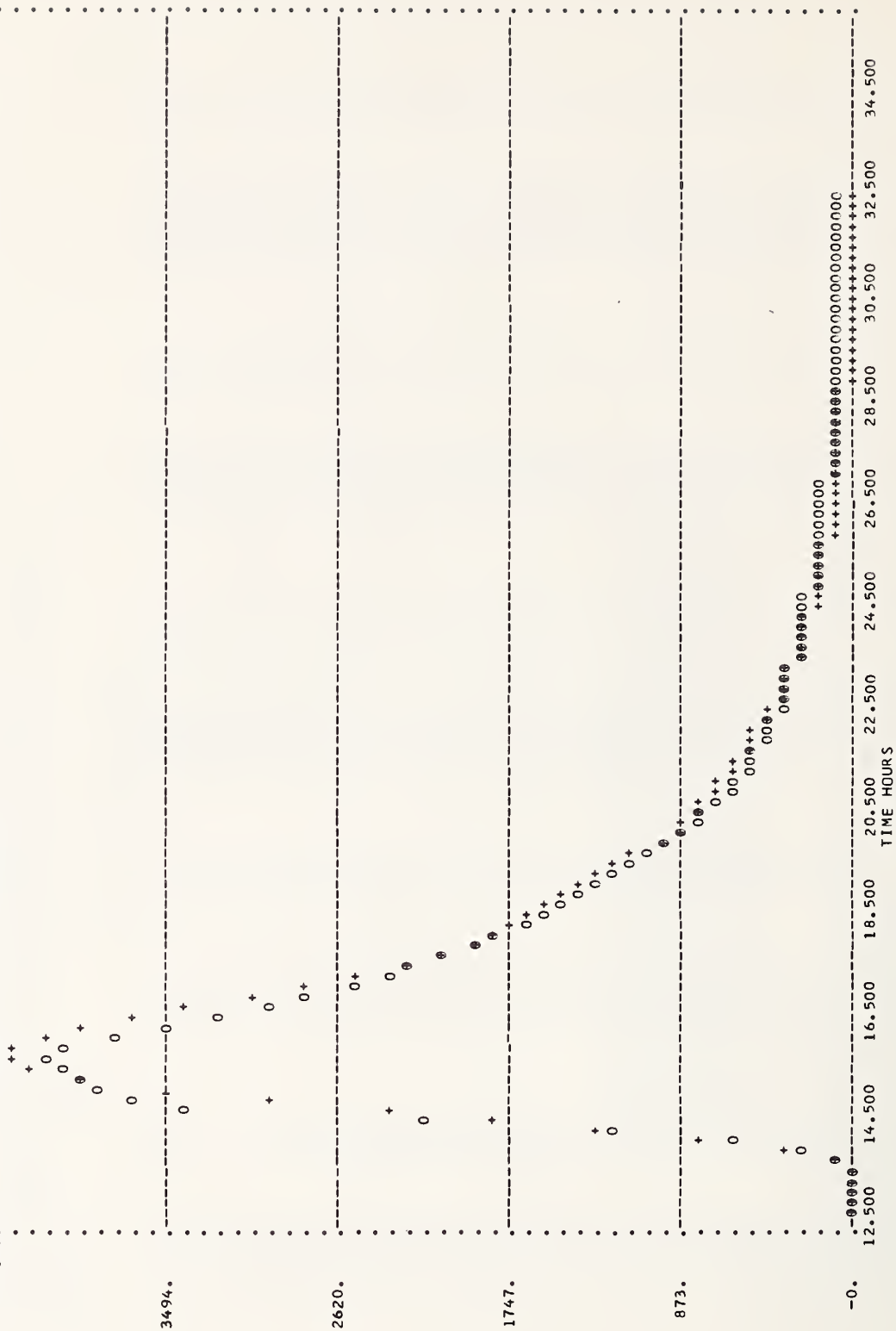
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* THE SEDIMENT YIELD COMMAND IS USED TO COMPUTE THE SEDIMENT YIELD PRODUCED BY *
* THE ROUTED FLOOD.
*
* SEDIMENT YIELD IO=6 SOIL=.34 CROP=.16 CP=.4 LS=.3
* SEDIMENT YIELD = 4116.9 TONS
* THE MEASURED SEDIMENT YIELD FOR THIS FLOOD WAS 3916 TONS.
* THE ROUTED FLOW HYDROGRAPH CAN BE COMPARED WITH THE MEASURED HYDROGRAPH BY
* PLOTTING AND ERROR ANALYSIS
*
* STORE THE MEASURED HYDROGRAPH
*
* STORE HYO
IO=2 HYO NO=5 OT=.1666667 OA=6.84
FLOW RATE = 0 0 0 0 0 100 220 400 790 1350 2200 3400
3650 3800 3920 4020 4100 4200 4100 3910 3700 3500 3280 3070
2860 2700 2550 2400 2290 2150 2000 1900 1800 1700 1620 1530
1460 1380 1300 1210 1150 1090 1000 970 900 820 800 750 700
670 620 600 570 530 510 500 490 470 430 400 390 380 370 350
340 330 320 310 300 300 290 270 260 240 220 210 210 200 200
200 190 190 180 180 180 170 170 160 160 160 150 150 150 150
150 150 140 140 140 140 140 140 140 130 120 120 120 120 120
120 110 110 110 110 110 110 110 110 100 100 90

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*

* PLOT SYMBOLS--- MEASURED HYD ---0--- ROUTED HYD ---+---
PLOT HYD MEASURED IO=2 ROUTED IO=6
4367. CFS.



* THE ERROR ANALYSIS COMMAND IS USED TO COMPUTE THE MAGNITUDE OF THE ERROR *

* ERROR ANALYSIS MEASURED ID=2 (FLOW ONE) ROUTED ID=6 (FLOW TWO)

TIME	FLOW 1	FLOW 2	ERROR
HRS	CFS	CFS	CFS
12.500	0.	0.	0.
12.700	0.	0.	-0.
12.900	0.	0.	-0.
13.100	0.	0.	-0.
13.300	0.	3.	-3.
13.500	0.	15.	-15.
13.700	124.	106.	18.
13.900	292.	378.	-86.
14.100	634.	829.	-195.
14.300	1238.	1349.	-111.
14.500	2250.	1855.	345.
14.700	3450.	2403.	1047.
14.900	3710.	2983.	727.
15.100	3872.	3537.	335.
15.300	4000.	3968.	32.
15.500	4100.	4260.	-160.
15.700	4180.	4367.	-187.
15.900	4024.	4337.	-313.
16.100	3784.	4181.	-397.
16.300	3540.	3950.	-410.
16.500	3280.	3684.	-404.
16.700	3028.	3415.	-387.
16.900	2796.	3143.	-347.
17.100	2610.	2880.	-270.
17.300	2430.	2611.	-181.
17.500	2290.	2353.	-63.
17.700	2120.	2137.	-17.
17.900	1960.	1978.	-18.
18.100	1840.	1869.	-29.
18.300	1720.	1783.	-63.
18.500	1620.	1707.	-87.
18.700	1516.	1628.	-112.
18.900	1428.	1541.	-113.
19.100	1332.	1446.	-114.
19.300	1228.	1347.	-119.
19.500	1150.	1244.	-94.
19.700	1072.	1141.	-69.
19.900	988.	1044.	-56.
20.100	928.	959.	-31.
20.300	836.	889.	-53.
20.500	800.	833.	-33.
20.700	740.	788.	-48.
20.900	688.	749.	-61.
21.100	640.	714.	-74.
21.300	604.	678.	-71.
21.500	570.	641.	-78.
21.700	526.	604.	-62.
21.900	506.	568.	-38.
22.100	494.	532.	-23.
22.300	474.	497.	-36.
22.500	430.	466.	-38.
22.700	398.	436.	-21.
22.900	386.	407.	

23.100	374.	379.	-5.
23.300	354.	354.	0.
23.500	340.	331.	9.
23.700	328.	312.	16.
23.900	316.	294.	22.
24.100	304.	279.	25.
24.300	300.	265.	35.
24.500	290.	251.	39.
24.700	268.	237.	31.
24.900	252.	223.	29.
25.100	228.	211.	17.
25.300	212.	200.	12.
25.500	210.	190.	20.
25.700	200.	181.	19.
25.900	200.	172.	28.
26.100	194.	164.	30.
26.300	190.	156.	34.
26.500	190.	148.	42.
26.700	180.	141.	39.
26.900	176.	135.	41.
27.100	170.	129.	41.
27.300	162.	123.	39.
27.500	160.	118.	42.
27.700	158.	112.	46.
27.900	150.	107.	43.
28.100	150.	103.	47.
28.300	150.	98.	52.
28.500	150.	94.	56.
28.700	148.	89.	59.
28.900	140.	85.	55.
29.100	140.	81.	59.
29.300	140.	78.	62.
29.500	140.	75.	65.
29.700	140.	72.	68.
29.900	136.	69.	67.
30.100	124.	67.	57.
30.300	120.	64.	56.
30.500	120.	61.	59.
30.700	120.	59.	61.
30.900	120.	56.	64.
31.100	114.	54.	60.
31.300	110.	52.	58.
31.500	110.	49.	61.
31.700	110.	47.	63.
31.900	110.	45.	65.
32.100	110.	42.	68.
32.300	102.	40.	62.
32.500	100.	38.	62.

ERROR STANOARD OEVIATION = 177.294
 PEAK DISCHARGE ERROR = 3.99 PERCENT

* THIS COMPLETES THE ROUTING FOR THE WATERSHEO IN ITS PRESENT CONOITION. *

* NEXT ASSUME FLOOD DETENTION RESERVOIRS ARE CONSTRUCTED TO CONTROL THE RUNOFF

* FROM AREAS 301 AND 306. TO EVALUATE THE EFFECTS OF THESE RESERVOIRS ON THE

* FLOOD HYDROGRAPH THE FLOOD OF MARCH 29, 1965 IS ROUTED THROUGH THE WATERSHEO

* WITH THE RESERVOIRS INSTALLED. SINCE THE PUNCH CODE WAS USED FOR THE FIRST

* ROUTING, ALL CAROS FOR THE SECONO ROUTING WERE PUNCHEO BY THE COMPUTER.

* HOWEVER, ROUTE RESERVOIR COMMANDS MUST BE MANUALLY PUNCHED AND PLACED IN THE

* PROGRAM TO ROUTE THROUGH THE PROPOSED RESERVOIRS. ALSO SOME OF THE COMPUTER

* PUNCHED COMMENT CAROS ARE CHANGED OR DELETED.

* THE FIRST STEP IS TO STORE THE HYO FROM AREA 301. NOTICE THE ID NUMBER IS

* CHANGED FROM 1 TO 5 SO THE RESERVOIR OUTFLOW CAN BE STORED IN IO 1 TO MAKE IT

* CCMPATABLE WITH THE STORE TRAVEL TIME AND ROUTE COMMANDS FOR REACH 2.

* RECALL HYO

ID=5	HYO NO=3D1	OT= 0.166667 HRS	OA= 1.734 SQ MI
PEAK=	2360.CFS	RO= 4.933 INCHES	NO PTS=105 FLOW RATE
0.	0.	0.	0.
90.	220.	1025.	1380.
2360.	2110.	1885.	1760.
1150.	1000.	860.	560.
370.	365.	380.	400.
330.	300.	270.	415.
140.	130.	120.	235.
110.	100.	100.	110.
60.	50.	47.	80.
33.	31.	29.	41.
20.	18.	17.	25.
12.	11.	10.	15.
8.	7.	7.	9.
5.	4.	4.	6.
3.	3.	3.	4.
			2.
			1.

ROUTE	RESERVOIR	ID=1	HYD NO=501	INFLOW	ID=5	REMAINING
		DATA	DEFINE	RESERVOIR	OUTFLOW	STORAGE
		OUTFLOW(CFS)	STORAGE(AC FT)			
		0		50		
		22		533		
		200		555		
		1000		601		
		2000		648		
		3000		694		

★ PRINT HYD ID=1

OUTFLOW HYDROGRAPH RESERVOIR 501

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS	HRS	CFS
12.500	0.	17.500	20.	22.500	20.	27.499	20.	32.499	20.	37.499	20.	42.499	20.	47.499	20.	52.499	20.	57.499	20.
12.667	0.	17.667	17.	22.666	20.	27.666	20.	32.666	20.	37.666	20.	42.666	20.	47.666	20.	52.666	20.	57.666	20.
12.833	0.	17.833	18.	22.833	20.	27.833	20.	32.832	20.	37.833	20.	42.833	20.	47.833	20.	52.833	20.	57.833	20.
13.000	0.	18.000	18.	23.000	20.	28.000	20.	33.000	20.	38.000	20.	43.000	20.	48.000	20.	53.000	20.	58.000	20.
13.167	0.	18.167	18.	23.166	20.	28.166	20.	33.166	20.	38.166	20.	43.166	20.	48.166	20.	53.166	20.	58.166	20.
13.333	0.	18.333	18.	23.333	20.	28.333	20.	33.332	20.	38.333	20.	43.333	20.	48.333	20.	53.333	20.	58.333	20.
13.500	0.	18.500	18.	23.500	20.	28.500	20.	33.499	20.	38.499	20.	43.499	20.	48.499	20.	53.499	20.	58.499	20.
13.667	0.	18.667	19.	23.666	20.	28.666	20.	33.666	20.	38.666	20.	43.666	20.	48.666	20.	53.666	20.	58.666	20.
13.833	1.	18.833	19.	23.833	20.	28.833	20.	33.832	20.	38.832	20.	43.832	20.	48.832	20.	53.832	20.	58.832	20.
14.000	1.	19.000	19.	24.000	20.	29.000	20.	34.000	20.	39.000	20.	44.000	20.	49.000	20.	54.000	20.	59.000	20.
14.167	1.	19.166	19.	24.166	20.	29.166	20.	34.166	20.	39.166	20.	44.166	20.	49.166	20.	54.166	20.	59.166	20.
14.333	2.	19.333	19.	24.333	20.	29.333	20.	34.332	20.	39.333	20.	44.333	20.	49.333	20.	54.333	20.	59.333	20.
14.500	3.	19.500	19.	24.500	20.	29.500	20.	34.500	20.	39.500	20.	44.500	20.	49.500	20.	54.500	20.	59.500	20.
14.667	5.	19.666	19.	24.666	20.	29.666	20.	34.666	20.	39.666	20.	44.666	20.	49.666	20.	54.666	20.	59.666	20.
14.833	6.	19.833	19.	24.833	20.	29.832	20.	34.832	20.	39.832	20.	44.832	20.	49.832	20.	54.832	20.	59.832	20.
15.000	7.	20.000	19.	24.999	20.	29.999	20.	34.999	20.	39.999	20.	44.999	20.	49.999	20.	54.999	20.	59.999	20.
15.167	9.	20.166	19.	25.166	20.	30.166	20.	35.165	20.	40.165	20.	45.165	20.	50.165	20.	55.165	20.	60.165	20.
15.333	10.	20.333	19.	25.333	20.	30.333	20.	35.332	20.	40.332	20.	45.332	20.	50.332	20.	55.332	20.	60.332	20.
15.500	11.	20.500	20.	25.499	20.	30.499	20.	35.499	20.	40.499	20.	45.499	20.	50.499	20.	55.499	20.	60.499	20.
15.667	12.	20.666	20.	25.666	20.	30.666	20.	35.665	20.	40.665	20.	45.665	20.	50.665	20.	55.665	20.	60.665	20.
15.833	13.	20.833	20.	25.833	20.	30.832	20.	35.832	20.	40.832	20.	45.832	20.	50.832	20.	55.832	20.	60.832	

RUNOFF VOLUME = 0.382 INCHES
PEAK DISCHARGE RATE = 20.0 CFS

```

* NEXT ROUTE THE OUTFLOW HYD FROM RESERVOIR 501 THROUGH REACH 2.
* BEFORE ROUTING THE TRAVEL TIME - DEPTH - FLOW RELATIONSHIP MUST BE COMPUTED
* FOR THE REACH.
*
STORE TRAVEL TIME      ID=2      REACH NO= 2.0 LENGTH= 3400. FT
SLOPE=0.002900FT/FT
DEPTH(FT)      FLOW(CFS)      TIME(HRS)
0.30      2.      0.832
0.68      6.      0.597
1.07      16.     0.498
1.58      38.     0.472
2.18      86.     0.390
2.75      153.    0.338
3.28      252.    0.343
3.66      371.    0.364
4.02      545.    0.359
4.45      810.    0.359
4.78      1064.   0.360
5.13      1431.   0.363
5.50      1980.   0.353
5.86      2672.   0.341
6.29      3670.   0.336
6.67      4853.   0.332
6.98      6225.   0.307
7.29      7793.   0.286
7.60      9613.   0.267
DT=0.200000HRS

ROUTE      ID=2      HYD NU=101      INFLOW ID=1
PRINT HYD      ID=2      CODE=1

```

```

PARTIAL HYDROGRAPH 101

RUNOFF VOLUME = 0.411 INCHES
PEAK DISCHARGE RATE = 20.0 CFS

```

* TO OBTAIN THE OUTFLOW HYD FROM REACH 2 THE HYD FROM AREA 302 MUST BE COMPUTED*
 * AND ADDED TO THE ROUTED HYD 101.

RECALL HYD ID=1 HYD NO=302 DT= 0.166667 HRS DA= 0.837 SQ MI
 PEAK= 572.CFS R0= 4.124 INCHES NO PTS=154
 FLOW RATES

0.	0.	0.	1.	2.	9.
36.	89.	169.	332.	411.	491.
548.	570.	572.	532.	495.	451.
407.	363.	326.	300.	282.	264.
223.	204.	193.	193.	211.	219.
212.	201.	188.	174.	160.	135.
125.	115.	109.	117.	124.	127.
125.	120.	113.	106.	92.	86.
81.	75.	70.	65.	57.	53.
49.	46.	43.	40.	37.	33.
32.	30.	29.	27.	26.	24.
23.	22.	21.	20.	19.	18.
17.	16.	16.	15.	14.	13.
13.	12.	12.	11.	11.	10.
9.	9.	9.	8.	8.	7.
7.	6.	6.	5.	4.	4.
3.	3.	3.	2.	2.	2.
2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

* * * COMPUTE THE HYD FROM AREA 303. *

ID=2		HYD NO=303		DT= 0.166667 HRS		OA= 1.108 SQ MI	
PEAK= 674.CFS		RD= 4.131 INCHES		NO PTS=175			
FLOW RATES							
0.	0.	0.	0.	1.	2.	8.	
33.	84.	164.	253.	341.	433.	528.	
604.	648.	671.	674.	660.	632.	594.	
550.	504.	462.	428.	404.	379.	354.	
328.	304.	287.	281.	292.	297.	295.	
285.	273.	257.	240.	223.	206.	191.	
177.	164.	155.	160.	165.	168.	169.	
166.	162.	155.	148.	140.	132.	125.	
118.	110.	103.	97.	90.	85.	80.	
75.	71.	67.	63.	60.	56.	53.	
51.	48.	46.	43.	42.	40.	38.	
37.	35.	34.	33.	32.	31.	29.	
28.	27.	26.	26.	25.	24.	23.	
22.	21.	21.	20.	19.	19.	18.	
17.	17.	16.	16.	15.	14.	14.	
13.	13.	13.	12.	12.	11.	11.	
11.	10.	10.	9.	9.	9.	8.	
8.	8.	8.	7.	7.	7.	7.	
6.	6.	5.	5.	4.	4.	3.	
3.	2.	2.	2.	2.	2.	2.	
2.	2.	2.	1.	1.	1.	1.	
1.	1.	1.	1.	1.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

* TO OBTAIN THE OUTFLOW FROM REACH 3, ADD HYD FROM AREA 303 TO ROUTED HYD 102.**

AOO HYD
PRINT HYD

IO=3
ID=3

HYD NO= 3
CODE=0

ID I=1

ID I1=2

OUTFLOW HYDROGRAPH REACH 3

TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS	TIME HRS	FLOW CFS
12.500	0.	19.000	424.	25.499	78.	31.999	31.	38.499	15.	38.499	15.	38.499	15.	38.499	15.	38.499	15.	38.499	15.	38.499	15.
12.567	0.	19.166	395.	25.666	76.	32.166	30.	38.665	14.	38.665	14.	38.665	14.	38.665	14.	38.665	14.	38.665	14.	38.665	14.
12.833	0.	19.333	368.	25.833	74.	32.333	30.	38.832	13.	38.832	13.	38.832	13.	38.832	13.	38.832	13.	38.832	13.	38.832	13.
13.000	0.	19.500	342.	25.999	72.	32.499	30.	38.999	12.	38.999	12.	38.999	12.	38.999	12.	38.999	12.	38.999	12.	38.999	12.
13.167	1.	19.666	318.	26.166	71.	32.666	30.	39.165	11.	39.165	11.	39.165	11.	39.165	11.	39.165	11.	39.165	11.	39.165	11.
13.333	3.	19.833	300.	26.333	68.	32.833	28.	39.332	10.	39.332	10.	39.332	10.	39.332	10.	39.332	10.	39.332	10.	39.332	10.
13.500	9.	20.000	300.	26.499	66.	32.999	28.	39.499	9.	39.499	9.	39.499	9.	39.499	9.	39.499	9.	39.499	9.	39.499	9.
13.667	42.	20.166	305.	26.666	64.	33.166	28.	39.665	9.	39.665	9.	39.665	9.	39.665	9.	39.665	9.	39.665	9.	39.665	9.
13.833	120.	20.333	310.	26.833	62.	33.332	28.	39.832	8.	39.832	8.	39.832	8.	39.832	8.	39.832	8.	39.832	8.	39.832	8.
14.000	252.	20.500	313.	26.999	62.	33.499	27.	39.999	7.	39.999	7.	39.999	7.	39.999	7.	39.999	7.	39.999	7.	39.999	7.
14.167	406.	20.666	311.	27.166	60.	33.666	27.	40.165	7.	40.165	7.	40.165	7.	40.165	7.	40.165	7.	40.165	7.	40.165	7.
14.333	558.	20.833	305.	27.333	58.	33.832	26.	40.332	6.	40.332	6.	40.332	6.	40.332	6.	40.332	6.	40.332	6.	40.332	6.
14.500	709.	21.000	294.	27.499	57.	33.999	25.	40.499	6.	40.499	6.	40.499	6.	40.499	6.	40.499	6.	40.499	6.	40.499	6.
14.667	870.	21.166	283.	27.666	55.	34.166	24.	40.665	5.	40.665	5.	40.665	5.	40.665	5.	40.665	5.	40.665	5.	40.665	5.
14.833	1011.	21.333	268.	27.833	54.	34.332	24.	40.832	5.	40.832	5.	40.832	5.	40.832	5.	40.832	5.	40.832	5.	40.832	5.
15.000	1110.	21.500	253.	27.999	53.	34.499	23.	40.998	5.	40.998	5.	40.998	5.	40.998	5.	40.998	5.	40.998	5.	40.998	5.
15.167	1174.	21.666	239.	28.166	52.	34.666	23.	41.165	4.	41.165	4.	41.165	4.	41.165	4.	41.165	4.	41.165	4.	41.165	4.
15.333	1202.	21.833	225.	28.333	50.	34.832	22.	41.332	4.	41.332	4.	41.332	4.	41.332	4.	41.332	4.	41.332	4.	41.332	4.
15.500	1197.	22.000	212.	28.499	50.	35.000	21.	41.498	4.	41.498	4.	41.498	4.	41.498	4.	41.498	4.	41.498	4.	41.498	4.
15.667	1160.	22.166	199.	28.666	48.	35.165	21.	41.665	4.	41.665	4.	41.665	4.	41.665	4.	41.665	4.	41.665	4.	41.665	4.
15.833	1103.	22.333	188.	28.833	47.	35.332	21.	41.832	3.	41.832	3.	41.832	3.	41.832	3.	41.832	3.	41.832	3.	41.832	3.
16.000	1031.	22.500	176.	28.999	46.	35.499	21.	41.998	3.	41.998	3.	41.998	3.	41.998	3.	41.998	3.	41.998	3.	41.998	3.
16.167	953.	22.666	167.	29.166	45.	35.665	21.	42.165	3.	42.165	3.	42.165	3.	42.165	3.	42.165	3.	42.165	3.	42.165	3.
16.333	877.	22.833	157.	29.333	45.	35.832	21.	42.332	3.	42.332	3.	42.332	3.	42.332	3.	42.332	3.	42.332	3.	42.332	3.
16.500	810.	23.000	149.	29.499	43.	35.999	21.	42.498	3.	42.498	3.	42.498	3.	42.498	3.	42.498	3.	42.498	3.	42.498	3.
16.667	759.	23.166	141.	29.666	42.	36.165	21.	42.665	3.	42.665	3.	42.665	3.	42.665	3.	42.665	3.	42.665	3.	42.665	3.
16.833	710.	23.333	134.	29.832	42.	36.332	20.	42.832	2.	42.832	2.	42.832	2.	42.832	2.	42.832	2.	42.832	2.	42.832	2.
17.000	662.	23.500	127.	29.999	40.	36.499	20.	42.998	2.	42.998	2.	42.998	2.	42.998	2.	42.998	2.	42.998	2.	42.998	2.
17.167	614.	23.666	121.	30.166	40.	36.665	20.	43.165	2.	43.165	2.	43.165	2.	43.165	2.	43.165	2.	43.165	2.	43.165	2.
17.333	569.	23.833	114.	30.332	39.	36.832	20.	43.332	2.	43.332	2.	43.332	2.	43.332	2.	43.332	2.	43.332	2.	43.332	2.
17.500	533.	24.000	109.	30.499	38.	36.999	20.	43.498	2.	43.498	2.	43.498	2.	43.498	2.	43.498	2.	43.498	2.	43.498	2.
17.667	514.	24.166	105.	30.666	37.	37.165	20.	43.665	2.	43.665	2.	43.665	2.	43.665	2.	43.665	2.	43.665	2.	43.665	2.
17.833	520.	24.333	100.	30.832	36.	37.332	20.	43.832	2.	43.832	2.	43.832	2.	43.832	2.	43.832	2.	43.832	2.	43.832	2.
18.000	526.	24.499	97.	30.999	35.	37.499	20.	43.998	1.	43.998	1.	43.998	1.	43.998	1.	43.998	1.	43.998	1.	43.998	1.
18.167	526.	24.666	92.	31.166	35.	37.665	20.	44.165	1.	44.165	1.	44.165	1.	44.165	1.	44.165	1.	44.165	1.	44.165	1.
18.333	516.	24.833	90.	31.332	33.	37.832	18.	44.332	1.	44.332	1.	44.332	1.	44.332	1.	44.332	1.	44.332	1.	44.332	1.
18.500	502.	24.999	87.	31.499	33.	37.999	17.	44.498	1.	44.498	1.	44.498	1.	44.498	1.	44.498	1.	44.498	1.	44.498	1.
18.667	479.	25.166	84.	31.666	32.	38.165	16.	44.665	1.	44.665	1.	44.665	1.	44.665	1.	44.665	1.	44.665	1.	44.665	1.
18.833	452.	25.333	81.	31.832	31.	38.332	16.	44.832	1.	44.832	1.	44.832	1.	44.832	1.	44.832	1.	44.832	1.	44.832	1.

RUNOFF VOLUME = 2.375 INCHES
PEAK DISCHARGE RATE = 1201.8 CFS

* ** ADD THE HYD FROM AREA 304 TO THE PARTIAL HYD 103 TO OBTAIN THE OUTFLOW FROM
* REACH 4.

*

* ROUTE THROUGH REACH 5.

*

STORE TRAVEL TIME ID=1 REACH NO= 5.0 LENGTH= 3310. FT

SLOPE=0.003000FT/FT

DEPTH(FT) FLOW(CFS) TIME(HRS)

0.35 2. 0.749

0.96 9. 0.542

1.57 26. 0.400

2.19 52. 0.317

2.82 90. 0.267

3.45 141. 0.231

4.28 237. 0.220

5.30 461. 0.210

6.13 818. 0.208

6.83 1317. 0.195

7.47 1958. 0.177

8.09 2750. 0.161

8.71 3713. 0.148

9.31 4861. 0.137

9.78 5880. 0.132

10.18 6694. 0.132

10.77 8589. 0.127

11.33 11067. 0.120

11.89 14199. 0.113

ID=1 HYD NO=104 INFLOW ID=3

ID=1 CODE=1

DT=0.200000HRS

PARTIAL HYDROGRAPH 104

RUNOFF VOLUME = 2.686 INCHES

PEAK DISCHARGE RATE = 1610.2 CFS

RECALL HYD

ID=2 HYD NO=305 DT= 0.333333 HRS DA= 1.875 SQ MI

PEAK= 937.CFS RO= 3.837 INCHES NO PTS=117

FLOW RATES

0.	0.	0.	2.	28.	157.	363.
61.	821.	924.	937.	880.	793.	729.
67.	610.	550.	517.	474.	425.	373.
32.	278.	240.	216.	197.	182.	167.
15.	145.	136.	128.	119.	111.	104.
9.	93.	87.	81.	75.	70.	65.
60.	56.	52.	49.	46.	43.	41.
38.	36.	34.	32.	30.	29.	27.
26.	24.	23.	22.	21.	20.	18.
17.	17.	16.	15.	14.	13.	13.
12.	11.	11.	10.	9.	8.	8.
8.	8.	7.	7.	6.	6.	6.
5.	5.	5.	4.	3.	2.	1.
1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.

```
* ADD THE HYD FROM AREA 305 TO THE PARTIAL HYD 104.
*
ADD HYD      ID=3      HYD NO=105      ID I=1      ID II=2
PRINT HYD    ID=3      CODE=1

      PARTIAL HYDROGRAPH 105

      RUNOFF VOLUME =      3.025 INCHES
      PEAK DISCHARGE RATE =      2542.0 CFS

* THE HYD FROM AREA 306 IS RECALLED AND USED AS THE INFLOW HYD TO RESERVOIR 502
*
RECALL HYD    ID=5      HYD NO=306      DT= 0.250000 HRS      DA= 0.483 SQ MI
              PEAK = 638.CFS      RO= 3.369 INCHES      NO PTS= 61      FLOW RATE
              0.      0.      0.      0.      45.      280.      560.
              638.      570.      370.      258.      170.      97.      72.
              64.      61.      80.      70.      59.      54.      52.
              51.      50.      46.      44.      40.      38.      33.
              30.      27.      25.      24.      23.      22.      21.
              20.      20.      19.      18.      16.      15.      15.
              13.      11.      9.      8.      7.      6.      6.
              5.      5.      5.      4.      4.      3.      3.
              3.      2.      2.      2.      1.

* ROUTE THE HYD FROM AREA 306 THROUGH RESERVOIR 502.
*
ROUTE RESERVOIR  ID=1      HYD NO=502      INFLOW ID=5
OUTFLOW(CFS)      STORAGE(AC FT)
0
.1      1      2.5
.2      5
.4      8
.6      15
6.      148
50      155
200     167
500     180

PRINT HYD      ID=1      CODE=1

      OUTFLOW HYDROGRAPH RESERVOIR 502

      RUNOFF VOLUME =      0.369 INCHES
      PEAK DISCHARGE RATE =      3.4 CFS
```

* ROUTE OUTFLOW FROM RESERVOIR 502 THROUGH REACH 6.

*

STORE	TRAVEL TIME	ID=2	REACH NO=	6.0	LENGTH=	4080. FT
DEPTH(FT)	FLOW(CFS)	TIME(HRS)				
0.44	5.	0.589				
0.80	16.	0.406				
1.18	33.	0.335				
1.52	56.	0.285				
1.88	88.	0.252				
2.26	146.	0.249				
2.66	251.	0.248				
3.10	421.	0.240				
3.55	675.	0.228				
4.00	1019.	0.216				
4.46	1482.	0.205				
4.93	2102.	0.192				
5.40	2902.	0.179				
5.88	3908.	0.167				
6.37	5214.	0.154				
6.85	6796.	0.142				
7.33	8649.	0.132				
7.80	10796.	0.123				
8.28	13261.	0.116				
ROUTE PRINT	HYD	ID=2	HYD NO=106	INFLOW	ID=1	DT=0.200000HRS
		IO=2	CODE=1			

PARTIAL HYDROGRAPH 106

RUNOFF VOLUME = 0.381 INCHES
PEAK DISCHARGE RATE = 3.4 CFS

✱

ID I=3

7709

OUTFLOW HYDROGRAPH REACH 5

[illegible]

RUNOFF VOLUME = 2.838 INCHES
 PEAK DISCHARGE RATE = 2544.1 CFS

* THE SEDIMENT YIELD COMMAND IS USED TO COMPUTE THE SEDIMENT YIELD PRODUCED BY *

* THE ROUTED FLOOD.

* SEDIMENT YIELD ID=6 SCIL=.34 CROP=.16 CP=.4 LS=.3

SEDIMENT YIELD = 2444.6 TONS

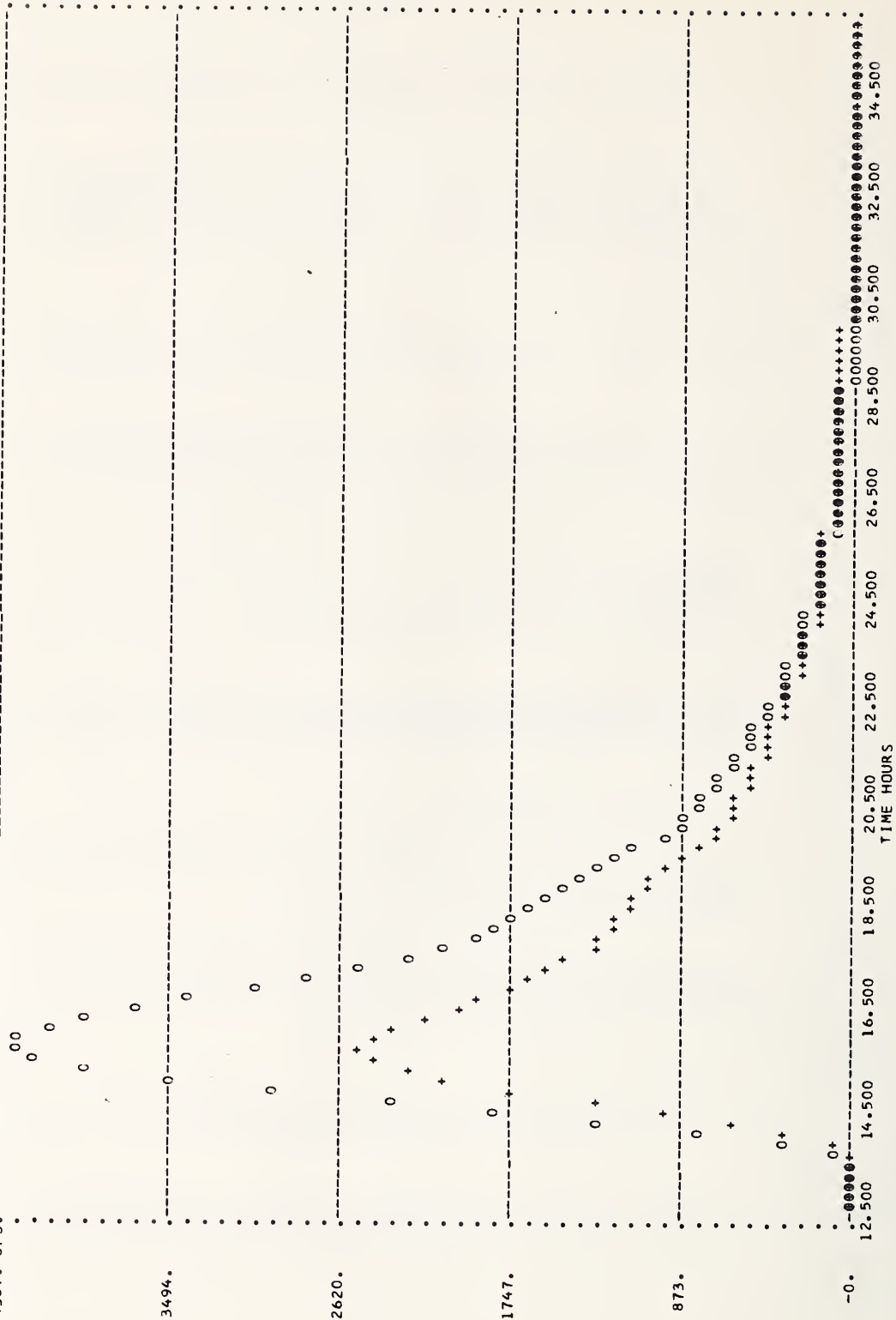
* RECALL THE REACH 5 OUTFLOW HYD ROUTED WITH PRESENT CONDITIONS.

* RECALL HYD ID=2 HYD NO= 5 DT= 0.200000 HRS DA= 6.844 SQ MI

PEAK= 4367.CFS RD= 4.196 INCHES NO PTS=104

0.	0.	0.	3.	15.	106.
378.	829.	1349.	2403.	2983.	3537.
3968.	4260.	4367.	4181.	3950.	3684.
3415.	3143.	2880.	2353.	2137.	1978.
1869.	1783.	1707.	1541.	1446.	1347.
1244.	1141.	1044.	889.	833.	788.
749.	714.	678.	604.	568.	532.
497.	466.	436.	407.	354.	331.
312.	294.	279.	251.	237.	223.
211.	200.	190.	172.	164.	156.
148.	141.	135.	123.	118.	112.
107.	103.	98.	89.	85.	81.
78.	75.	72.	67.	64.	61.
59.	56.	54.	49.	47.	45.
42.	40.	38.	35.	33.	31.
30.	29.	28.	25.	24.	22.
21.	20.	19.	17.	16.	15.
15.	14.	13.	12.	12.	11.
11.	10.	10.	9.	7.	7.
7.	7.	6.	6.	6.	6.
5.	5.	5.	4.	4.	3.
3.	2.	2.	1.	1.	1.
1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

* PLOT THE REACH 5 OUTFLOW HYDS ROUTED WITH PRESENT CONDITIONS AND WITH *
 * RESERVOIRS.
 * PLOT SYMBOLS PRESENT CONDITIONS--O-- WITH RESERVOIRS---+---
 PLOT HYD ID I=2 ID II=6
 4367. CFS.



FINISH

LITERATURE CITED

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APPENDIX

HYMO MAIN PROGRAM AND SUBROUTINES

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//SOPTIONS
C                                     HYMO
C
C THIS PROGRAM IS A PROBLEM ORIENTED COMPUTER LANGUAGE FOR
C DEVELOPING WATERSHED MODELS.
C
C
C DEFINITION OF VARIABLES
C ID = STORAGE LOCATION NUMBER
C NHD = HYDROGRAPH IDENTIFICATION NUMBER
C DT = TIME INCREMENT IN HOURS
C DA = DRAINAGE AREA IN SQ MI
C OCFS = FLOW RATE ARRAY
C OCFSF = CUTOFF FLOW RATE IN CFS
C IEND = NUMBER OF POINTS IN A HYDROGRAPH
C SCFS = FLOW RATE ARRAY FOR TRAVEL TIME TABLE
C A = END AREA IN SQ FT
C Q = FLOW RATE ARRAY FOR RATING CURVES
C RAIN = MASS RAINFALL ARRAY
1 COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD
1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO
2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT
3(6),TIME,PEAK(6),ROIN,ISG(6)
2 NCCDE=0
C READ ZALFA ARRAY
3 READ (5,20) (ZALFA(I),I=1,15)
C READ NUMBER OF COMMANDS
4 READ (5,21) NCOMM
C READ COMMAND TABLE
5 READ (5,22) ((CTBLE(I,J),J=1,11),(ITBLE(I,J),J=1,2),I=1,NCOMM)
6 WRITE (6,23) (ZALFA(I),I=1,15)
7 WRITE (6,24)
8 WRITE (6,25) ((CTBLE(I,J),J=1,11),(ITBLE(I,J),J=1,2),I=1,NCOMM)
C ZERO CODES -- NPU = PUNCH, ICC = CONTINUATION CARD, NER = ERROR
9 NPU=0
10 ICC=0
11 1 NER=0
12 CALL HONDO
13 IF (NER) 2,2,19
14 2 GO TO (3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19), NCODE
15 3 TIME=DATA(1)
16 NPU=DATA(2)
17 GO TO 1
18 4 CALL STHYD
19 GO TO 1
20 5 CALL RECHD
21 GO TO 1
22 6 CALL CMPHYD
23 GO TO 1
24 7 CALL PRTHYD
25 GO TO 1
26 8 CALL PUHYD
27 GO TO 1
28 9 CALL HPLOT
29 GO TO 1
30 10 CALL ADHYD
31 GO TO 1
32 11 CALL SRC
33 GO TO 1
34 12 CALL CMPRC

```


	C	IF NOT NUMBER SEARCH COMMAND TABLE FOR MATCH	B	38
	C	CALL FIRST 10 VALUES FROM PERMANENT DATA STORAGE	B	39
79		DO 14 I=1,50	B	40
80		DO 13 J=1,11	B	41
81		IF (CTBLE(I,J)-ALPHA(J)) 14,13,14	B	42
	C	SN 10=PART MATCH	B	43
82	13	CONTINUE	B	44
	C	IF THIS LOOP IS COMPLETED WE HAVE COMPLETE MATCH- CALL NCODE	B	45
	C	AND MAX NUMBER AND EXIT LOOP	B	46
83		NCODE=ITBLE(I,1)	B	47
84		MAXNO=ITBLE(I,2)	B	48
85		GO TO 21	B	49
86	14	CONTINUE	B	50
	C	IF MAJOR LOOPS FINISHED WITHOUT A MATCH WRITE ERROR MESSAGE	B	51
	C	AND SET NER = 1	B	52
87		NER=1	B	53
88		WRITE (6,46)	B	54
89		RETURN	B	55
	C	CONVERT DIGIT INPUT CODE FROM ALPHAMERIC TO INTEGER FORM	B	56
90	15	NCODE=GIT(ALPHA,1,2,1.)*0.5	B	57
	C	FIND MAX NUMBER OF DATA ITEMS FOR THIS NCODE	B	58
91		DO 17 I=1,50	B	59
92		IF (ITBLE(I,1)-NCODE) 17,16,17	B	60
93	16	MAXNO=ITBLE(I,2)	B	61
94		GO TO 21	B	62
95	17	CONTINUE	B	63
	C	SEARCH DATA ROUTINE	B	64
	C	SEE IF ANY DATA FOR THIS CARD	B	65
96		DO 19 I=1,50	B	66
97		IF (ITBLE(I,1)-NCODE) 19,18,19	B	67
98	18	MAXNO=ITBLE(I,2)	B	68
99		GO TO 20	B	69
100	19	CONTINUE	B	70
101	20	CONTINUE	B	71
102	21	IF (MAXNO) 23,22,23	B	72
103	22	RETURN	B	73
	C	ZERO ARRAYS AND COUNTERS	B	74
104	23	DO 47 I=1,310	B	75
105	47	DATA (I)=0.	B	76
106		NDATA=1	B	77
107	24	NCHAR=0	B	78
108	25	DO 26 I=1,10	B	79
109		AUXA(I)=0.	B	80
110	26	AUXB(I)=0.	B	81
111		IT1=1	B	82
112		IT2=1	B	83
113		SIGN=1.	B	84
114		LDGIT=0	B	85
115		KDGIT=0	B	86
	C	CARRY OUT DIGIT BY DIGIT SEARCH AND ACCUMULATION	B	87
116	27	NCHAR=NCHAR+1	B	88
	C	HAVE WE CONSIDERED ALL CHARACTERS - RETURN IF SO	B	89
117		IF (NCHAR-60) 28,32,1	B	90
118	28	DO 29 I=1,15	B	91
119		IF (CHAR(NCHAR)-ZALFA(I)) 29,30,29	B	92
120	29	CONTINUE	B	93
121		GO TO 32	B	94
122	30	GO TO (33,33,33,33,33,33,33,33,33,33,32,27,36,32,31,27), I	B	95
	C	SN 39 HANDLES SIGN CONTROL ON 1130 VERSION	B	96
123	31	SIGN=-1.0	B	97

124		GO TO 27	B	98
	C	CHARACTER IS BLANK OR COMMA - DOES IT FOLLOW A DIGIT	B	99
125	32	GO TO (27,48), IT1	B	100
	C	CHARACTER IS A DIGIT - HAS A DECIMAL BEEN ENCOUNTERED	B	101
126	33	GO TO (34,35), IT2	B	102
127	34	LDGIT=LDGIT+1	B	103
128		IT1=2	B	104
129		AUXA(LDGIT)=CHAR(NCHAR)	B	105
130		GO TO 27	B	106
131	35	KDGIT=KDGIT+1	B	107
132		AUXB(KDGIT)=CHAR(NCHAR)	B	108
133		GO TO 27	B	109
	C	CHARACTER IS A DECIMAL - DOES IT FOLLOW A DIGIT	B	110
134	36	GO TO (37,38), IT1	B	111
135	37	IT1=2	B	112
136		LDGIT=1	B	113
137	38	IT2=2	B	114
138		GO TO 27	B	115
	C	ROUTINE TO CONVERT ALPHABETIC ARRAY TO FLOATING POINT NUMBER	B	116
139	48	DATA (NDATA)=GIT(AUXA,1,LDGIT,1.)+GIT(AUXB,1,10,0.)	B	117
140		DATA (NDATA)=DATA(NDATA)*SIGN	B	118
	C	IS ALL DATA FURNISHED YES-RETURN NO INCREASE N DATA KEEP ON	B	119
141		IF (NDATA-MAXNO) 41,39,39	B	120
142	39	ICC=0	B	121
143	40	RETURN	B	122
144	41	NDATA=NDATA+1	B	123
145		GO TO 25	B	124
	C		B	125
146	42	FORMAT (2A1,9A2,60A1)	B	126
147	43	FORMAT (1H1)	B	127
148	44	FORMAT (5X,2A1,9A2,60A1)	B	128
149	45	FORMAT (2A1,9A2,60A1)	B	129
150	46	FORMAT (10X,20HCOMMAND NOT IN TABLE)	B	130
151		END	B	131-
152		FUNCTION GIT (TCARD,J,JLAST,SHIFT)	C	1
153		DIMENSION TCARD(10), A(10)	C	2
154		DATA A(1)/1H1/,A(2)/1H2/,A(3)/1H3/,A(4)/1H4/,A(5)/1H5/,A(6)/1H6/	C	3
155		DATA A(7)/1H7/,A(8)/1H8/,A(9)/1H9/,A(10)/1H0/	C	4
156		GIT=0.	C	5
157		TEN=10.	C	6
158		SUM=0.	C	7
159		DO 3 JNOW=J,JLAST	C	8
160		TTEST=TCARD(JNOW)	C	9
	C	CHECK FOR LAST ENTRY	C	10
161		IF (TTEST.EQ.0.) GO TO 4	C	11
	C	FIND NUMBER AND COMPUTE VALUE	C	12
162		DO 2 NUMB=1,10	C	13
163		IF (TTEST-A(NUMB)) 2,1,2	C	14
164	1	ZTEST=NUMB	C	15
165		IF (ZTEST.EQ.10.) ZTEST=0.	C	16
166		SUM=SUM*TEN+ZTEST	C	17
167		GO TO 3	C	18
168	2	CONTINUE	C	19
169	3	CONTINUE	C	20
170	4	IF (SHIFT) 6,5,6	C	21
171	5	FI=JNOW-1	C	22
172		SUM=SUM*(0.1**FI)	C	23
173	6	GIT=SUM	C	24
174		RETURN	C	25

175	END	C	26-
176	SUBROUTINE STHYD	D	1
C	THIS SUBROUTINE STORES THE COORDINATES OF HYDROGRAPHS.	D	2
177	COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	D	3
	1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	D	4
	2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	D	5
	3(6),TIME,PEAK(6),ROIN,ISG(6)	D	6
178	ID=DATA(1)	D	7
179	NHD=DATA(2)	D	8
180	DT(ID)=DATA(3)	D	9
181	DA(ID)=DATA(4)	D	10
182	J=5	D	11
C	REMAINING DATA ARE FLOW RATES	D	12
183	OCFS(1,ID)=DATA(J)	D	13
184	PEAK(ID)=1.	D	14
185	RO=DATA(J)	D	15
186	DO 4 I=2,300	D	16
187	J=J+1	D	17
188	OCFS(I,ID)=DATA(J)	D	18
189	RO=RO+OCFS(I,ID)	D	19
C	IS FLOW RECEDING	D	20
190	IF (OCFS(I,ID)-OCFS(I-1,ID)) 1,2,2	D	21
C	HAS FLOW RECEDED TO CUTOFF RATE	D	22
191	1 IF (OCFS(I,ID)) 5,5,4	D	23
C	DETERMINE PEAK FLOW	D	24
192	2 IF (OCFS(I,ID)-PEAK(ID)) 4,4,3	D	25
193	3 PEAK(ID)=OCFS(I,ID)	D	26
194	4 CONTINUE	D	27
195	5 IEND(ID)=I-1	D	28
196	M=IEND(ID)	D	29
197	ROIN=(RO*DT(ID))/(DA(ID)*645.333)	D	30
C	PUNCH CODE	D	31
198	IF (NPU) 7,7,6	D	32
199	6 WRITE (7,8) ID,NHD,DT(ID),DA(ID),PEAK(ID),ROIN,IEND(ID)	D	33
200	WRITE (7,9) (OCFS(J,ID),J=1,M)	D	34
201	7 RETURN	D	35
C		D	36
202	8 FORMAT('RECALL HYD',T21,'ID=',I1,T29,'HYD NO=',I3,T42,'DT=',F9.	D	37
	16,' HRS',T61,'DA=',F8.3,' SQ MI'/T21,'PEAK=',F7.0,'CFS',T40,'RO=',	D	38
	2F6.3,' INCHES',T59,'NO PTS=',I3/T21,'FLOW RATES')	D	39
203	9 FORMAT (T21,7F8.0)	D	40
204	END	D	41-
205	SUBROUTINE RECHD	E	1
C	THIS SUBROUTINE RECALLS PREVIOUSLY COMPUTED AND PUNCHED	E	2
C	HYDROGRAPHS	E	3
206	COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	E	4
	1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	E	5
	2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	E	6
	3(6),TIME,PEAK(6),ROIN,ISG(6)	E	7
207	ID=DATA(1)	E	8
208	NHD=DATA(2)	E	9
209	DT(ID)=DATA(3)	E	10
210	DA(ID)=DATA(4)	E	11
211	PEAK(ID)=DATA(5)	E	12
212	ROIN=DATA(6)	E	13
213	IEND(ID)=DATA(7)	E	14
214	M=IEND(ID)	E	15
215	J=8	E	16

216	C	REMAINING DATA ARE FLOW RATES	E	17
217		DO 1 I=1,M	E	18
218		OCFS(I,ID)=DATA(J)	E	19
219	1	J=J+1	E	20
220		RETURN	E	21
		END	E	22-
221		SUBROUTINE CMPHYD	F	1
	C	THIS PROGRAM DEVELOPS A UNIT HYDROGRAPH, CONVERTS MASS RAINFALL	F	2
	C	TO POINT RUNOFF, AND COMPUTES STORM HYDROGRAPHS BY SUMMATION.	F	3
222		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	F	4
		1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	F	5
		2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	F	6
		3(6),TIME,PEAK(6),ROIN,ISG(6)	F	7
223		ID=DATA(1)	F	8
224		NHD=DATA(2)	F	9
225		DT(ID)=DATA(3)	F	10
226		DA(ID)=DATA(4)	F	11
227		CN=DATA(5)	F	12
	C	ARE K AND TP FURNISHED OR WILL THEY BE COMPUTED	F	13
228		IF (DATA(6)) 1,2,2	F	14
229	1	XK=-DATA(6)	F	15
230		TP=-DATA(7)	F	16
231		GO TO 3	F	17
232	2	HT=DATA(6)	F	18
233		XL=DATA(7)	F	19
234		SLOPE=HT/XL	F	20
235		XLDW=(XL**2.)/DA(ID)	F	21
236		XK=27.0*(DA(ID)**.231)*(SLOPE**(-.777))*(XLDW**.124)	F	22
237		TP=4.63*(DA(ID)**.422)*(SLOPE**(-.46))*(XLDW**.133)	F	23
238	3	PEAK(ID)=1.	F	24
239		DO 4 I=1,300	F	25
240	4	OCFS(I,ID)=0.	F	26
	C	COMPUTE N BY ITERATION.	F	27
241		XN=5.0	F	28
242		XKTP=XK/TP	F	29
243		DO 6 I=1,50	F	30
244		TINF=1.+SQRT(1./{XN-1.})	F	31
245		XN1=.05/(XKTP*(ALOG(TINF/(TINF+.05))+.05))+1.	F	32
246		DIFF=ABS(XN1-XN)	F	33
247		IF (DIFF-.001) 7,7,5	F	34
248	5	XN=XN1	F	35
249	6	CONTINUE	F	36
250		WRITE (6,29)	F	37
251		GO TO 28	F	38
	C	DETERMINE C1.	F	39
252	7	DELT=TINF/100.	F	40
253		TC1=0.	F	41
254		XN1P=XN-1.	F	42
255		XN1M=1.-XN	F	43
256		DO 8 I=2,101	F	44
257		TC1=TC1+DELT	F	45
258	8	CFS(I)=(TC1**XN1P)*EXP(XN1M*(TC1-1.))	F	46
259		SUM=CFS(101)/2.	F	47
260		DO 9 I=2,100	F	48
261	9	SUM=SUM+CFS(I)	F	49
262		C1=SUM*DELT	F	50
263		CFS11=CFS(101)	F	51
264		TTINF=TINF*TP	F	52
265		TRECI=TTINF+2.*XK	F	53

266		EEE=EXP((TTINF-TREC1)/XK)	F	54
267		XK1=3.*XK	F	55
268		B=645.333/(C1+CFSI*(XK*TP*(1.-EEE)+EEE*(XK1/TP)))	F	56
	C	COMPUTE B, QP, AND CFSI.	F	57
269		QP=(B*DA(ID))/TP	F	58
270		CFSI=QP*CFS(101)	F	59
271		CFSR1=CFSI*EEE	F	60
272		WRITE (6,30) XN,QP	F	61
	C	DETERMINE INCREMENTAL RUNOFF.	F	62
273		R=1000./CN-10.	F	63
274		B1=.2*R	F	64
275		J=8	F	65
276		IF (DATA(J)) 13,10,10	F	66
277	10	RAIN(1)=DATA(J)	F	67
278		DO 11 I=2,300	F	68
279		J=J+1	F	69
280		RAIN(I)=DATA(J)	F	70
281		IF (RAIN(I)-RAIN(I-1)) 12,11,11	F	71
282	11	CONTINUE	F	72
283	12	NUMB=I-1	F	73
284	13	DO 15 I=1,NUMB	F	74
285		IF (RAIN(I)-B1) 33,33,14	F	75
286	33	DATA (I)=0.	F	76
287		Q1=0.	F	77
288		GO TO 15	F	78
289	14	Q2=((RAIN(I)-B1)**2.)/(RAIN(I)+.8*R)	F	79
290		DATA (I)=Q2-Q1	F	80
291		Q1=Q2	F	81
292	15	CONTINUE	F	82
	C	COMPUTE UNIT HYDROGRAPH.	F	83
293		T2=0.	F	84
294		CFS(1)=0.	F	85
295		DO 20 I=2,300	F	86
296		T2=T2+DT(ID)	F	87
297		IF (T2-TTINF) 16,16,17	F	88
298	16	CFS(I)=QP*((T2/TP)**XN1P)*EXP(XN1M*(T2/TP-1.))	F	89
299		GO TO 20	F	90
300	17	IF (T2-TREC1) 18,18,19	F	91
301	18	CFS(I)=CFSI*EXP((TTINF-T2)/XK)	F	92
302		GO TO 20	F	93
303	19	CFS(I)=CFSR1*EXP((TREC1-T2)/XK1)	F	94
304		IF (CFS(I)-1.) 21,21,20	F	95
305	20	CONTINUE	F	96
306		I=300	F	97
307	21	ICND=I	F	98
	C	COMPUTE STORM HYDROGRAPH.	F	99
308		DO 24 J=2,NUMB	F	100
309		N=J+ICND-2	F	101
310		IF (N-300) 23,23,22	F	102
311	22	N=300	F	103
312	23	KK=J	F	104
313		I=2	F	105
314		DO 24 K=KK,N	F	106
315		OCFS(K,ID)=OCFS(K,ID)+DATA(J)*CFS(I)	F	107
316	24	I=I+1	F	108
317		M=K-1	F	109
318		RO=0.	F	110
319		DO 26 I=2,M	F	111
	C	COMPUTE RUNOFF VOLUME	F	112
320		RO=RO+OCFS(I, ID)	F	113

	C	DETERMINE PEAK	F 114
321		IF (OCFS(I,ID)-PEAK(ID)) 26,26,25	F 115
322	25	PEAK(ID)=OCFS(I,ID)	F 116
323	26	CONTINUE	F 117
324		I=M	F 118
325		IEND(ID)=I	F 119
326		M=I	F 120
327		ROIN=(RO*DT(ID))/(DA(ID)*645.333)	F 121
	C	PUNCH CODE	F 122
328		IF (NPU) 28,28,27	F 123
329	27	WRITE (7,31) ID,NHD,DT(ID),DA(ID),PEAK(ID),ROIN,IEND(ID)	F 124
330		WRITE (7,32) (OCFS(I,ID),I=1,M)	F 125
331	28	RETURN	F 126
	C		F 127
332	29	FORMAT('N DID NOT CONVERGE AFTER 50 ITERATIONS.')	F 128
333	30	FORMAT(T10,'SHAPE CCNSTANT, N = ',F6.3/T10,'UNIT PEAK = ',F10.1,'C IFS'/)	F 129
334	31	FORMAT(' RECALL HYD',T21,'ID=',I1,T29,'HYD NO=',I3,T42,'DT=',F9. 16,' HRS',T61,'DA=',F8.3,' SQ MI'/T21,'PEAK=',F7.0,'CFS',T40,'RO=', 2F6.3,' INCHES',T59,'NO PTS=',I3/T21,'FLOW RATES')	F 130 F 131 F 132
335	32	FORMAT (T21,7F8.0)	F 133
336		END	F 134-
337		SUBROUTINE PRTHYD	G 1
	C	THIS SUBROUTINE PRINTS THE COORDINATES OF A HYDROGRAPH.	G 2
338		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD 1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO 2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT 3(6),TIME,PEAK(6),ROIN,ISG(6)	G 3 G 4 G 5 G 6
339		ID=DATA(1)	G 7
340		NPK=DATA(2)	G 8
	C	DETERMINE TYPE OF HYDROGRAPH	G 9
341		IF (NHD-100) 6,6,2	G 10
342	1	WRITE (6,14) NHD	G 11
343		GO TO 7	G 12
344	2	IF (NHD-300) 3,3,4	G 13
345	3	WRITE (6,15) NHD	G 14
346		GO TO 7	G 15
347	4	IF (NHD-500) 1,1,5	G 16
348	5	WRITE (6,16) NHD	G 17
349		GO TO 7	G 18
350	6	WRITE (6,17) NHD	G 19
	C	POSITIVE NPK MEANS PRINT ONLY PEAK AND VOLUME	G 20
351	7	IF (NPK) 8,8,11	G 21
352	8	J=0	G 22
353		WRITE (6,18)	G 23
354		M=IEND(ID)	G 24
355		TIME1=TIME	G 25
	C	BUILD TIME ARRAY IN DATA	G 26
356		DO 9 I=1,M	G 27
357		DATA (I)=TIME1	G 28
358	9	TIME1=TIME1+DT(ID)	G 29
359		M4=M+4	G 30
360		M5=M4/5	G 31
361	10	J=J+1	G 32
362		WRITE (6,19) (DATA(I),OCFS(I,ID),I=J,M,M5)	G 33
363		IF (J-M5) 10,11,11	G 34
364	11	WRITE (6,20) ROIN,PEAK(ID)	G 35
365		IF (NPU) 13,13,12	G 36
366	12	WRITE (7,21) ID,NPK	G 37

62

404	6	L=ID1	I	26
405		K=ID2	I	27
406		GO TO 8	I	28
407	7	L=ID2	I	29
408		K=ID1	I	30
409	8	M=IEND(L)	I	31
410		TID=DT(K)	I	32
411		TIDH=0.	I	33
412		DO 11 I=2,M	I	34
413		TIDH=TIDH+DT(L)	I	35
414		IF (TID-TIDH) 10,9,11	I	36
415	9	J=J+1	I	37
416		CFS(J)=OCFS(I,L)	I	38
417		TID=TID+DT(K)	I	39
418		GO TO 11	I	40
419	10	J=J+1	I	41
420		CFS(J)=OCFS(I-1,L)+((TID-TIDH+DT(L))/DT(L))*(OCFS(I,L)-OCFS(I-1,L))	I	42
		1)	I	43
421		TID=TID+DT(K)	I	44
422	11	CONTINUE	I	45
423		IEND(L)=J	I	46
424		DT(L)=DT(K)	I	47
425		DO 12 I=2,J	I	48
426	12	OCFS(I,L)=CFS(I)	I	49
427	13	IF (IEND(ID1)-IEND(ID2)) 14,14,15	I	50
428	14	M=IEND(ID1)	I	51
429		GO TO 16	I	52
430	15	M=IEND(ID2)	I	53
431	16	IF (M-MAX) 17,17,18	I	54
	C	DETERMINE TIME SCALE	I	55
432	17	MRT0=MAX/M	I	56
433		XMRT0=MRT0	I	57
434		GO TO 19	I	58
435	18	M=MAX	I	59
436	19	YSCL=QMAX/50.	I	60
	C	PLOT HYDROGRAPHS	I	61
437		DO 20 I=1,MAX	I	62
438	20	CFS(I)=DASH	I	63
439		WRITE (6,41) QMAX,(CFS(I),I=1,MAX),DOT	I	64
440		Q1=QMAX	I	65
441		J1=10	I	66
442		DO 37 J=1,50	I	67
443		IF (J-J1) 23,21,23	I	68
444	21	DO 22 I=1,MAX	I	69
445	22	CFS(I)=DASH	I	70
446		GO TO 25	I	71
447	23	DO 24 I=1,MAX	I	72
448	24	CFS(I)=BLANK	I	73
449	25	Q2=Q1-YSCL	I	74
450		K=1	I	75
451		DO 28 I=2,M	I	76
452		K=K+MRT0	I	77
453		IF (OCFS(I,ID1)-Q1) 26,27,28	I	78
454	26	IF (OCFS(I,ID1)-Q2) 28,28,27	I	79
455	27	CFS(K)=ZERO	I	80
456	28	CONTINUE	I	81
457		WRITE (6,44) DOT,(CFS(I),I=1,MAX),DOT	I	82
458		IF (ID2) 34,34,29	I	83
459	29	K=1	I	84
460		DO 33 I=2,M	I	85

461		K=K+MR TO	I	86
462		IF (OCFS(I,ID2)-Q1) 30,31,32	I	87
463	30	IF (OCFS(I,ID2)-Q2) 32,32,31	I	88
464	31	CFS(K)=PLUS	I	89
465		GO TO 33	I	90
466	32	CFS(K)=BLANK	I	91
467	33	CONTINUE	I	92
468		WRITE (6,42) (CFS(I),I=1,MAX)	I	93
469	34	IF (J-J1) 36,35,36	I	94
470	35	J1=J1+10	I	95
471		WRITE (6,43) Q2	I	96
472	36	Q1=Q2	I	97
473	37	CONTINUE	I	98
474		CFS(1)=TIME	I	99
475		DTT=DT(ID1)*10./XMRT0	I	100
	C	PUT TIME ARRAY IN CFS AND WRITE TIME SCALE	I	101
476		DO 38 I=2,12	I	102
477	38	CFS(I)=CFS(I-1)+DTT	I	103
478		WRITE (6,45) (CFS(I),I=1,12)	I	104
479		WRITE (6,46)	I	105
480		IF (NPU) 40,40,39	I	106
481	39	WRITE (7,47) ID1,ID2	I	107
482	40	RETURN	I	108
	C		I	109
483	41	FORMAT(1X,F6.0,' CFS.',119A1)	I	110
484	42	FORMAT (1H+,11X,118A1)	I	111
485	43	FORMAT (1H+,F6.0)	I	112
486	44	FORMAT (11X,120A1)	I	113
487	45	FORMAT (6X,12F10.3)	I	114
488	46	FORMAT(49X,'TIME HOURS'///)	I	115
489	47	FORMAT(' PLOT HYD',T21,'ID I=',I1,T29,'ID II=',I1)	I	116
490		END	I	117-
491		SUBROUTINE ADHYD	J	1
	C	THIS SUBROUTINE ADDS TWO HYDROGRAPHS.	J	2
492		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	J	3
		1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	J	4
		2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	J	5
		3(6),TIME,PEAK(6),ROIN,ISG(6)	J	6
493		ID=DATA(1)	J	7
494		NHD=DATA(2)	J	8
495		ID1=DATA(3)	J	9
496		ID2=DATA(4)	J	10
497		PEAK(ID)=1.	J	11
	C	MAKE TIME INCREMENTS EQUAL IF NOT EQUAL. USE SMALLER INCREMENT	J	12
498		IF (DT(ID1)-DT(ID2)) 1,3,2	J	13
499	1	DT(ID)=DT(ID1)	J	14
500		L=ID1	J	15
501		K=ID2	J	16
502		GO TO 6	J	17
503	2	DT(ID)=DT(ID2)	J	18
504		L=ID2	J	19
505		K=ID1	J	20
506		GO TO 6	J	21
507	3	DT(ID)=DT(ID1)	J	22
508		IF (IEND(ID1)-IEND(ID2)) 4,4,5	J	23
509	4	M3=IEND(ID1)	J	24
510		K1=ID2	J	25
511		IEND(ID)=IEND(ID2)	J	26
512		GO TO 18	J	27

513	5	M3=IEND(ID2)	J	28
514		K1=ID1	J	29
515		IEND(ID)=IEND(ID1)	J	30
516		GO TO 18	J	31
	C	DETERMINE DURATIONS OF FLOW	J	32
517	6	XIEND1=IEND(ID1)-1	J	33
518		XIEND2=IEND(ID2)-1	J	34
519		DUR1=XIEND1*DT(ID1)	J	35
520		DUR2=XIEND2*DT(ID2)	J	36
521		IF (DUR1-DUR2) 7,8,8	J	37
522	7	IEND(ID)=DUR2/DT(ID)+1.	J	38
523		M3=DUR1/DT(ID)+1.	J	39
524		K1=ID2	J	40
525		GO TO 9	J	41
526	8	IEND(ID)=DUR1/DT(ID)+1.	J	42
527		M3=DUR2/DT(ID)+1.	J	43
528		K1=ID1	J	44
529	9	IF (IEND(ID)-300) 11,11,10	J	45
530	10	IEND(ID)=300	J	46
531	11	M2=IEND(K)	J	47
532		J=1	J	48
	C	INTERPOLATE ONE HYDROGRAPH IF NECESSARY	J	49
533		TIDH=0.	J	50
534		TID=DT(ID)	J	51
535		DO 15 I=2,M2	J	52
536		TIDH=TIDH+DT(K)	J	53
537	12	IF (TIDH-TID) 15,13,14	J	54
538	13	J=J+1	J	55
539		DATA (J)=OCFS(I,K)	J	56
540		TID=TID+DT(ID)	J	57
541		IF (J-300) 15,16,16	J	58
542	14	J=J+1	J	59
543		DATA (J)=OCFS(I-1,K)+((TID-TIDH+DT(K))/DT(K))*(OCFS(I,K)-OCFS(I-1,	J	60
		1K))	J	61
544		TID=TID+DT(ID)	J	62
545		IF (J-300) 12,16,16	J	63
546	15	CONTINUE	J	64
547	16	IEND(K)=J	J	65
548		DO 17 I=2,J	J	66
549	17	OCFS(I,K)=DATA(I)	J	67
550	18	M=IEND(ID)	J	68
551		DA(ID)=DA(ID1)+DA(ID2)	J	69
552		RO=0.	J	70
	C	ADD HYDROGRAPHS	J	71
553		DO 20 I=1,M3	J	72
554		OCFS(I,ID)=OCFS(I,ID1)+OCFS(I,ID2)	J	73
555		IF (OCFS(I,ID)-PEAK(ID)) 20,20,19	J	74
556	19	PEAK(ID)=OCFS(I,ID)	J	75
557	20	RO=RO+OCFS(I,ID)	J	76
558		IF (PEAK(ID)-PEAK(K1)) 21,22,22	J	77
559	21	PEAK(ID)=PEAK(K1)	J	78
560	22	IF (M-M3) 25,25,23	J	79
561	23	M3=M3+1	J	80
562		DO 24 I=M3,M	J	81
563		OCFS(I,ID)=OCFS(I,K1)	J	82
564	24	RO=RO+OCFS(I,ID)	J	83
565	25	ROIN=(RO*DT(ID))/(DA(ID)*645.333)	J	84
566		IF (NPU) 27,27,26	J	85
567	26	WRITE (7,28) ID,NHD,ID1,ID2	J	86
568	27	RETURN	J	87

569	C	28	FORMAT('ADD HYD',T21,'ID=',I1,T29,' HYD NO=',I3,T45,'ID I=',I1,	J	88
			1T60,'ID II=',I1)	J	89
570			END	J	90
				J	91-
571			SUBROUTINE SRC	K	1
	C		THIS SUBROUTINE STORES AN ELEVATION - END AREA - FLOW TABLE.	K	2
572			COMMON CFS(300),QCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	K	3
			1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	K	4
			2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	K	5
			3(6),TIME,PEAK(6),ROIN,ISG(6)	K	6
573			ID=DATA(1)	K	7
574			VS=DATA(2)	K	8
	C		VALLEY SECTION NUMBER	K	9
	C		REMAINING DATA ARE ELEVATION, AREA, AND FLOW FOR EACH POINT OF	K	10
	C		THE RATING CURVE	K	11
575			EMIN=DATA(3)	K	12
576			J=3	K	13
577			DO 1 I=1,20	K	14
578			ELEV=DATA(J)	K	15
579			DEEP(I,ID)=DATA(J)-EMIN	K	16
580			A(I,ID)=DATA(J+1)	K	17
581			Q(I,ID)=DATA(J+2)	K	18
582			J=J+3	K	19
583	1		CONTINUE	K	20
584			RETURN	K	21
585			END	K	22-
586			SURROUTINE CMPRC	L	1
	C		THIS SUBROUTINE COMPUTES THE DISCHARGE END-AREA ELEVATION	L	2
	C		RELATIONSHIP FOR A VALLEY SECTION.	L	3
587			COMMON CFS(300),QCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	L	4
			1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	L	5
			2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	L	6
			3(6),TIME,PEAK(6),ROIN,ISG(6)	L	7
588			ID=DATA(1)	L	8
	C		STORAGE LOCATION NUMBER. (1-6)	L	9
589			VS=DATA(2)	L	10
	C		VALLEY SECTION IDENTIFICATION NUMBER.	L	11
590			NSEG=DATA(3)	L	12
	C		NUMBER OF SEGMENTS IN THE VALLEY SECTION.	L	13
591			ELC=DATA(4)	L	14
592			EMAX=DATA(5)	L	15
	C		MAXIMUM ELEVATION FOR COMPUTATIONS.	L	16
593			SLOPE1=DATA(6)	L	17
	C		CHANNEL SLOPE.	L	18
594			SLOPE2=DATA(7)	L	19
	C		FLCOD PLAIN SLOPE.	L	20
595			DIF=(EMAX-ELC)/19.	L	21
596			C(1)=ELC	L	22
597			DO 1 I=2,20	L	23
598	1		C(I)=C(I-1)+DIF	L	24
	C		SET AREA AND DISCHARGE ARRAYS = 0.	L	25
599			DO 2 I=1,20	L	26
600			A(I,ID)=0.	L	27
601	2		Q(I,ID)=0.	L	28
602			J=8	L	29
603			WRITE (6,24) VS	L	30
	C		READ N VALUES AND SEGMENT BORDER POINTS.	L	31
604			DO 3 I=1,NSEG	L	32

605		SEGN(I)=DATA(J)	L	33
606		DIST(I)=DATA(J+1)	L	34
607	3	J=J+2	L	35
	C	REMAINING DATA ITEMS ARE DISTANCES AND ELEVATIONS.	L	36
608		JJJ=J	L	37
609		DO 6 I=1,NSEG	L	38
610	4	J=J+2	L	39
611		IF (DATA(J)-DIST(I)) 4,5,5	L	40
612	5	ISG(I)=J+1	L	41
613	6	CONTINUE	L	42
	C	COMPUTE DISCHARGES AND END AREAS FOR EACH SEGMENT.	L	43
614		DO 22 K=1,NSEG	L	44
615		J=JJJ	L	45
616		JJJ1=JJJ+1	L	46
617		IF (SEGN(K)) 7,7,8	L	47
618	7	SLOPE=SLOPE1	L	48
619		SEGN(K)=-SEGN(K)	L	49
620		GO TO 9	L	50
621	8	SLCPE=SLOPE2	L	51
622	9	SLPN=1.486*SLOPE**.5	L	52
	C	COMPUTE AREA AND DISCHARGE FOR SEGMENT.	L	53
623		DO 21 I=2,20	L	54
624		AA=0.	L	55
625		P=0.	L	56
626		J=JJJ-1	L	57
627		DEP2=0.	L	58
628	10	J=J+2	L	59
629		IF (J-ISG(K)) 12,12,11	L	60
630	11	IF (AA-.001) 21,21,20	L	61
631	12	IF (DATA(J)-C(I)) 13,10,10	L	62
632	13	DEP1=C(I)-DATA(J)	L	63
633		IF (J-JJJ1) 16,16,14	L	64
634	14	XL=DATA(J-1)-DATA(J-3)	L	65
635		DEP3=ABS(DATA(J-2)-DATA(J))	L	66
636		XL=XL*DEP1/DEP3	L	67
637	15	AA=AA+XL*(DEP1+DEP2)/2.	L	68
638		P=P+SQRT((DEP1-DEP2)**2+XL**2)	L	69
639	16	DEP2=DEP1	L	70
640		J=J+2	L	71
641		IF (J-ISG(K)) 17,17,20	L	72
642	17	IF (DATA(J)-C(I)) 18,18,19	L	73
643	18	DEP1=C(I)-DATA(J)	L	74
644		XL=DATA(J-1)-DATA(J-3)	L	75
645		GO TO 15	L	76
646	19	DEP1=0.	L	77
647		XL=DATA(J-1)-DATA(J-3)	L	78
648		DEP3=ABS(DATA(J-2)-DATA(J))	L	79
649		XL=XL*DEP2/DEP3	L	80
650		AA=AA+XL*(DEP1+DEP2)/2.	L	81
651		P=P+SQRT((DEP1-DEP2)**2+XL**2)	L	82
652		DEP2=0.	L	83
653		GO TO 10	L	84
654	20	R=AA/P	L	85
655		SGN=SEGN(K)-.0025*R	L	86
	C	ADD DISCHARGES AND AREAS FOR ALL SEGMENTS TO OBTAIN TOTALS FOR	L	87
	C	VALLEY SECTION.	L	88
656		Q(I,ID)=Q(I,ID)+AA*R**.66667*SLPN/SGN	L	89
657		A(I,ID)=A(I,ID)+AA	L	90
658	21	CONTINUE	L	91
659		JJJ=J-3	L	92

660	22	CONTINUE		
661		DO 23 I=1,20	L	93
662		DEEP(I,ID)=C(I)-ELO	L	94
663		WRITE (6,25) C(I),A(I,ID),Q(I,ID)	L	95
664	23	CONTINUE	L	96
665		RETURN	L	97
	C		L	98
666	24	FORMAT(1H0,T42,'RATING CURVE VALLEY SECTION',F5.1/T46,'WATER',T56, 1'FLOW',T66,'FLOW'/T45,'SURFACE',T56,'AREA',T66,'RATE'/T46,'ELEV',T 256,'SQ FT',T66,'CFS')	L	99
			L	100
667	25	FORMAT (40X,F10.2,2F10.1)	L	101
668		END	L	102
			L	103
			L	104
669		SUBROUTINE STT	M	1
	C	THIS SUBROUTINE STORES A DEPTH - FLOW - TRAVEL TIME TABLE.	M	2
670		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD 1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO 2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT 3(6),TIME,PEAK(6),ROIN,ISG(6)	M	3
			M	4
			M	5
671		ID=DATA(1)	M	6
672		REACH=DATA(2)	M	7
673		XL=DATA(3)	M	8
674		SLOPE=DATA(4)	M	9
675		DIST(ID)=SLOPE*XL	M	10
676		J=5	M	11
677		DO 1 I=1,19	M	12
678		DP(I)=DATA(J)	M	13
679		SCFS(I)=DATA(J+1)	M	14
680		C(I)=DATA(J+2)	M	15
681	1	J=J+3	M	16
682		RETURN	M	17
683		END	M	18
			M	19
684		SUBROUTINE CMPTT	N	1
	C	THIS SUBROUTINE COMPUTES THE TRAVEL TIME AT GIVEN	N	2
	C	DISCHARGE RATES	N	3
685		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD 1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO 2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT 3(6),TIME,PEAK(6),ROIN,ISG(6)	N	4
			N	5
			N	6
686		ID=DATA(1)	N	7
687		REACH=DATA(2)	N	8
688		NOVS=DATA(3)	N	9
689		XL=DATA(4)	N	10
690		SLOPE=DATA(5)	N	11
691		DIST(ID)=SLOPE*XL	N	12
692		XLD36=XL/3600.	N	13
	C	ZERO ARRAYS	N	14
693		DO 1 J=1,20	N	15
694		DATA (J)=0.	N	16
695	1	CFS(J)=0.	N	17
696		ID1=1	N	18
	C	FIND RATING CURVE WITH SMALLEST MAXIMUM FLOW RATE	N	19
697	2	QMIN=Q(20,ID1)	N	20
698		MIN=ID1	N	21
699		GO TO 4	N	22
700	3	ID1=ID1+1	N	23
701		IF (QMIN-Q(20,ID1)) 4,4,2	N	24
702	4	IF (ID1-NOVS) 3,5,5	N	25
703	5	I=1	N	26
			N	27

	C	SET SCFS ARRAY EQUAL TO Q ARRAY OF LOWEST RATING CURVE	N	28
704		DO 6 J=2,20	N	29
705		SCFS(I)=Q(J,MIN)	N	30
706	6	I=I+1	N	31
	C	COMPUT END AREA AND DEPTH	N	32
707		DO 9 ID1=1,NOVS	N	33
708		DO 9 J=1,19	N	34
709		DO 7 I=2,20	N	35
710		IF (Q(I,ID1)-SCFS(J)) 7,17,8	N	36
711	7	CONTINUE	N	37
712	17	DATA (J)=A(I,ID1)+DATA(J)	N	38
713		CFS(J)=DEEP(I,ID1)+CFS(J)	N	39
714		GO TO 9	N	40
715	8	XY=(SCFS(J)-Q(I-1,ID1))/(Q(I,ID1)-Q(I-1,ID1))	N	41
716		DATA (J)=A(I-1,ID1)+XY*(A(I,ID1)-A(I-1,ID1))+DATA(J)	N	42
717		CFS(J)=DEEP(I-1,ID1)+XY*(DEEP(I,ID1)-DEEP(I-1,ID1))+CFS(J)	N	43
718	9	CONTINUE	N	44
719		XNCVS=NOVS	N	45
720		WRITE (6,13) REACH	N	46
	C	COMPUTE TRAVEL TIME	N	47
721		DO 10 I=1,19	N	48
722		AVAREA=DATA(I)/XNOVS	N	49
723		DP(I)=CFS(I)/XNOVS	N	50
724		S=AVAREA*XLD36	N	51
725		C(I)=S/SCFS(I)	N	52
726		WRITE (6,14) DP(I),SCFS(I),C(I)	N	53
727	10	CONTINUE	N	54
	C	PUNCH CODE	N	55
728		IF (NPU) 12,12,11	N	56
729	11	WRITE (7,15) ID,REACH,XL,SLOPE	N	57
730		WRITE (7,16) (DP(I),SCFS(I),C(I),I=1,19)	N	58
731	12	RETURN	N	59
	C		N	60
732	13	FORMAT(1H0,T46,'TRAVEL TIME TABLE'/T54,'REACH',F5.1//T46,'WATER',T	N	61
		156,'FLOW',T65,'TRAVEL'/T46,'DEPTH',T56,'RATE',T66,'TIME'/T46,'FEET	N	62
		2',T56,'CFS',T66,'HRS')	N	63
733	14	FORMAT (40X,F10.2,F10.0,F10.4)	N	64
734	15	FORMAT('STORE TRAVEL TIME',T21,'ID=',I1,T29,'REACH NO=',F5.1,T44,	N	65
		1'LENGTH=',F9.0,' FT'/T21,'SLOPE=',F8.6,'FT/FT' /T2	N	66
		21,'DEPTH(FT)',T35,'FLOW(CFS)',T49,'TIME(HRS)')	N	67
735	16	FORMAT (T21,F7.2,F15.0,F15.3)	N	68
736		END	N	69-
737		SUBROUTINE ROUTE	O	1
	C	THIS SUBROUTINE ROUTES A HYDROGRAPH THROUGH A REACH WITH THE	O	2
	C	NEW VSC METHOD OF FLOOD ROUTING. THIS METHOD ACCOUNTS FOR THE	O	3
	C	VARIATION IN WATER SURFACE SLOPE.	O	4
738		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	O	5
		1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	O	6
		2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	O	7
		3(6),TIME,PEAK(6),ROIN,ISG(6)	O	8
739		ID=DATA(1)	O	9
740		NHD=DATA(2)	O	10
741		IDH=DATA(3)	O	11
742		DT(ID)=DATA(4)	O	12
743		DA(ID)=DA(IDH)	O	13
744		M=IEND(IDH)	O	14
	C	IF ID AND IDH ARE EQUAL, ADD 1 TO IDH	O	15
745		IF (ID-IDH) 3,1,3	O	16
746	1	IDH=IDH+1	O	17

747		DO 2 I=1,M	0	18
748	2	OCFS(I,IDH)=OCFS(I,IDH-1)	0	19
749		DT(IDH)=DT(IDH-1)	0	20
750		PEAK(IDH)=PEAK(IDH-1)	0	21
751	3	NERRT=0	0	22
752		PEAK(ID)=1.	0	23
753		RO=0.	0	24
754		N=19	0	25
755		OCFS(1,ID)=0.	0	26
756		S=0.	0	27
757		T1=C(1)	0	28
758		J=1	0	29
759		GUES=1.	0	30
760		CFS(1)=0.	0	31
	C	IF ROUTING INTERVAL IS NOT EQUAL TO TIME INCREMENT OF INFLOW	0	32
	C	HYDROGRAPH, INTERPOLATE	0	33
761		IF (DT(ID)-DT(IDH)) 8,15,4	0	34
762	4	TID=DT(ID)	0	35
763		TIDH=0.	0	36
764		DO 7 I=2,M	0	37
765		TIDH=TIDH+DT(IDH)	0	38
766		IF (TID-TIDH) 6,5,7	0	39
767	5	J=J+1	0	40
768		CFS(J)=OCFS(I,IDH)	0	41
769		TIC=TID+DT(ID)	0	42
770		GO TO 7	0	43
771	6	J=J+1	0	44
772		CFS(J)=OCFS(I-1,IDH)+((TID-TIDH+DT(IDH))/DT(IDH))*(OCFS(I,IDH)-OCF	0	45
		IS(I-1,IDH))	0	46
773		TIC=TID+DT(ID)	0	47
774	7	CONTINUE	0	48
775		GO TO 13	0	49
776	8	TIDH=0.	0	50
777		TID=DT(ID)	0	51
778		DO 12 I=2,M	0	52
779		TIDH=TIDH+DT(IDH)	0	53
780	9	IF (TIDH-TID) 12,10,11	0	54
781	10	J=J+1	0	55
782		CFS(J)=OCFS(I,IDH)	0	56
783		TIC=TID+DT(ID)	0	57
784		IF (J-300) 12,13,13	0	58
785	11	J=J+1	0	59
786		CFS(J)=OCFS(I-1,IDH)+((TID-TIDH+DT(IDH))/DT(IDH))*(OCFS(I,IDH)-OCF	0	60
		IS(I-1,IDH))	0	61
787		TIC=TID+DT(ID)	0	62
788		IF (J-300) 9,13,13	0	63
789	12	CONTINUE	0	64
790	13	IEND(IDH)=J	0	65
791		DT(IDH)=DT(ID)	0	66
792		M=J	0	67
793		DO 14 I=2,M	0	68
794	14	OCFS(I,IDH)=CFS(I)	0	69
	C	IF INFLOW IS ZERO, SO IS OUTFLOW	0	70
795	15	DO 16 L=2,M	0	71
796		IF (OCFS(L,IDH)) 16,16,49	0	72
797	16	OCFS(L,ID)=0.	0	73
	C	ROUTE	0	74
798	49	DATA (L-1)=0.	0	75
799		DO 42 I=L,300	0	76
800		IF (I-M) 18,18,17	0	77

801	17	OCFS(I,IDH)=OCFS(I-1,IDH)*.9	0	78
802	18	AVIN=(OCFS(I,IDH)+OCFS(I-1,IDH))/2.	0	79
803		SIA=S+AVIN	0	80
804		J=1	0	81
	C	DETERMINE DEPTH AND TRAVEL TIME OF INFLOW	0	82
805		IF (OCFS(I,IDH)-SCFS(1)) 19,23,20	0	83
806	19	DI2=(OCFS(I,IDH)/SCFS(1))*DP(1)	0	84
807		TI2=C(1)	0	85
808		GO TO 25	0	86
809	20	DO 21 J=2,N	0	87
810		IF (OCFS(I,IDH)-SCFS(J)) 24,23,21	0	88
811	21	CONTINUE	0	89
812		IF (NERRT) 22,22,36	0	90
813	22	WRITE (6,46)	0	91
814		NERRT=1	0	92
815		GO TO 36	0	93
816	23	DI2=DP(J)	0	94
817		TI2=C(J)	0	95
818		GO TO 25	0	96
819	24	RATIO=(OCFS(I,IDH)-SCFS(J-1))/(SCFS(J)-SCFS(J-1))	0	97
820		DI2=DP(J-1)+RATIO*(DP(J)-DP(J-1))	0	98
821		TI2=C(J-1)+RATIO*(C(J)-C(J-1))	0	99
822	25	DO 35 IT=1,10	0	100
823		J=1	0	101
	C	DETERMINE DEPTH AND TRAVEL TIME OF OUTFLOW	0	102
824		IF (GUES-SCFS(1)) 26,29,27	0	103
825	26	DO2=(GUES/SCFS(1))*DP(1)	0	104
826		TO2=C(1)	0	105
827		GO TO 31	0	106
828	27	DO 28 J=2,N	0	107
829		IF (GUES-SCFS(J)) 30,29,28	0	108
830	28	CONTINUE	0	109
831		J=N	0	110
832	29	DO2=DP(J)	0	111
833		TO2=C(J)	0	112
834		GO TO 31	0	113
835	30	RATIO=(GUES-SCFS(J-1))/(SCFS(J)-SCFS(J-1))	0	114
836		DO2=DP(J-1)+RATIO*(DP(J)-DP(J-1))	0	115
837		TO2=C(J-1)+RATIO*(C(J)-C(J-1))	0	116
	C	FIND WATER SURFACE SLOPE	0	117
838	31	DDD=DIST(IC)/(DIST(ID)+CI2-DO2)	0	118
839		IF (DDD-.01) 32,32,33	0	119
840	32	GUES=OCFS(I-1,IDH)	0	120
841		GO TO 35	0	121
842	33	T2=.5*(TI2+TO2)	0	122
843		T2=T2*SQRT(DDD)	0	123
844		T=T1+T2	0	124
	C	COMPUTE ROUTING COEFFICIENT	0	125
845		COEF=(2.*DT(ID))/(T+DT(ID))	0	126
846		O2=COEF*SIA	0	127
847		TRY1=GUES	0	128
848		RATIO=O2/(GUES+.1E-20)	0	129
849		DIFF=ABS(1.-RATIO)	0	130
	C	TEST FOR CONVERGENCE	0	131
850		IF (DIFF-.001) 37,37,34	0	132
851	34	GUES=O2	0	133
852	35	CONTINUE	0	134
853		OCFS(I,ID)=DATA(I-1)*SIA	0	135
854		DATA(I)=DATA(I-1)	0	136
855		WRITE (6,47) I,OCFS(I,ID)	0	137

856		GO TO 38	O	138
857	36	OCFS(I,ID)=DATA(I-1)*SIA	O	139
858		DATA(I)=DATA(I-1)	O	140
859		GO TO 38	O	141
860	37	OCFS(I,ID)=O2	O	142
861		DATA(I)=COEF	O	143
	C	COMPUTE NEW STORAGE	O	144
862	38	S=SIA-OCFS(I,ID)	O	145
863		T1=T2	O	146
864		RO=RO+OCFS(I,ID)	O	147
865		IF (OCFS(I,ID)-OCFS(I-1,ID)) 39,40,40	O	148
866	39	IF (OCFS(I,ID)-1.) 43,43,42	O	149
867	40	IF (OCFS(I,ID)-PEAK(ID)) 42,42,41	O	150
868	41	PEAK(ID)=OCFS(I,ID)	O	151
869	42	CONTINUE	O	152
870		I=300	O	153
871	43	IEND(ID)=I	O	154
872		ROIN=(RO*DT(ID))/(DA(ID)*645.333)	O	155
	C	PUNCH CODE	O	156
873		IF (NPU) 45,45,44	O	157
874	44	WRITE (7,48) ID,NHD,IDH,DT(ID)	O	158
875	45	RETURN	O	159
	C		O	160
876	46	FORMAT(1H0,'TRAVEL TIME TABLE EXCEEDED')	O	161
877	47	FORMAT(10,'PROBLEM FAILED TO CONVERGE AFTER10 ITERATIONS. CONVERG 1ENCE WAS FORCED.'/T20,'OUTFLOW NUMBER = ',I4,'RATE = ',F10.2)	O	162
878	48	FORMAT('ROUTE',T21,'ID=',I1,T29,'HYD NO=',I3,T45,'INFLOW ID=',I 11,T65,'DT=',F8.6,'HRS')	O	163
879		END	O	164
			O	166-
880		SUBROUTINE RESVO	P	1
	C	THIS SUBROUTINE ROUTES A HYDROGRAPH THROUGH A RESERVOIR WITH THE	P	2
	C	STORAGE-INDICATION METHOD.	P	3
881		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD 1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO 2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT 3(6),TIME,PEAK(6),ROIN,ISG(6)	P	4
		ID=DATA(1)	P	5
882		NHD=DATA(2)	P	6
883		IDH=DATA(3)	P	7
884		NERES=0	P	8
885		DT(ID)=DT(IDH)	P	9
886		RO=0.	P	10
887		DA(ID)=DA(IDH)	P	11
888		PEAK(ID)=1.	P	12
889		J=1	P	13
890		I=4	P	14
891			P	15
	C	REMAINING DATA ARE FLOW AND STORAGE VALUES	P	16
892		SCFS(J)=DATA(I)	P	17
893		STORE1=DATA(I+1)*12.1	P	18
894		STORE=STORE1	P	19
	C	COMPUTE STORAGE COEFFICIENT ARRAY C	P	20
895	1	C(J)=(SCFS(J)/2.)+(STORE/DT(ID))	P	21
896		I=I+2	P	22
897		J=J+1	P	23
898		IF (J-20) 2,2,3	P	24
899	2	SCFS(J)=DATA(I)	P	25
900		STORE=DATA(I+1)*12.1	P	26
901		IF (SCFS(J)-.001) 3,3,1	P	27
902	3	N=J-1	P	28
			P	29
			P	30

903		OCFS(1,ID)=0.	P	31
904		S=STORE1/DT(ID)	P	32
	C	ROUTE	P	33
905		DO 15 I=2,150	P	34
906		IF (I-IEND(IDH)) 5,5,4	P	35
907	4	OCFS(I,IDH)=0.0	P	36
908	5	AVIN=(OCFS(I,IDH)+OCFS(I-1,IDH))/2.	P	37
909		SIA=S+AVIN	P	38
	C	DETERMINE PROPER C	P	39
910		DO 6 J=1,N	P	40
911		IF (SIA-C(J)) 10,9,6	P	41
912	6	CONTINUE	P	42
913		IF (NERES) 7,7,8	P	43
914	7	WRITE (6,19)	P	44
915		NERES=1	P	45
916	8	RESC=SCFS(N)/C(N)	P	46
	C	COMPUT OUTFLOW	P	47
917		OCFS(I,ID)=RESC*SIA	P	48
918		GO TO 11	P	49
919	9	OCFS(I,ID)=SCFS(J)	P	50
920		GO TO 11	P	51
921	10	OCFS(I,ID)=SCFS(J-1)+((SIA-C(J-1))/(C(J)-C(J-1)))*(SCFS(J)-SCFS(J-1))	P	52
	C	DETERMINE NEW STORAGE	P	53
922	11	S=SIA-OCFS(I,ID)	P	54
923		RO=RO+OCFS(I,ID)	P	55
924		IF (OCFS(I,ID)-OCFS(I-1,ID)) 12,13,13	P	56
925	12	IF (OCFS(I,ID)-1.) 16,16,15	P	57
926	13	IF (OCFS(I,ID)-PEAK(ID)) 15,15,14	P	58
927	14	PEAK(ID)=OCFS(I,ID)	P	59
928	15	CONTINUE	P	60
929		I=150	P	61
930	16	IEND(ID)=I	P	62
931		ROIN=RO*DT(ID)/(DA(ID)*645.333)	P	63
	C	PUNCH CODE	P	64
932		IF (NPU) 18,18,17	P	65
933	17	WRITE (7,20) ID,NHD,IDH	P	66
934		II=2*N+3	P	67
935		WRITE (7,21) (DATA(I),I=5,II)	P	68
936	18	RETURN	P	69
	C		P	70
937	19	FORMAT (1H0,33HSTORAGE-DISCHARGE TABLE EXCEEDED.)	P	71
938	20	FORMAT('ROUTE RESERVOIR',T21,'ID=',I1,T29,'HYD NO=',I3,T42,'INFLOW ID=',I1,T49,'OUTFLOW(CFS)',T37,'STORAGE(AC FT)')	P	72
		FORMAT(T21,F10.1,F13.1)	P	73
939	21	END	P	74
940			P	75
			P	76-
941		SUBROUTINE ERROR	Q	1
	C	THIS SUBROUTINE DETERMINES THE ERROR STANDARD DEVIATION AND THE	Q	2
	C	PEAK FLOW ERROR FOR 2 HYDROGRAPHS	Q	3
942		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	Q	4
		1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NFR,MAXNO,NCO	Q	5
		2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	Q	6
		3(6),TIME,PEAK(6),ROIN,ISG(6)	Q	7
943		ID1=DATA(1)	Q	8
944		ID2=DATA(2)	Q	9
945		SSE=0.	Q	10
946		WRITE (6,15)	Q	11
947		J=1	Q	12

948	C	IF TIME INCREMENTS NOT EQUAL, INTERPOLATE	Q	13
949	1	IF (DT(ID1)-DT(ID2)) 1,8,2	Q	14
950		L=ID1	Q	15
951		K=ID2	Q	16
952		GO TO 3	Q	17
953	2	L=ID2	Q	18
954		K=ID1	Q	19
955	3	M=IEND(L)	Q	20
956		TID=DT(K)	Q	21
957		TIDH=0.	Q	22
958		DO 6 I=2,M	Q	23
959		TIDH=TIDH+DT(L)	Q	24
960		IF (TID-TIDH) 5,4,6	Q	25
961	4	J=J+1	Q	26
962		CFS(J)=OCFS(I,L)	Q	27
963		TID=TID+DT(K)	Q	28
964		GO TO 6	Q	29
965	5	J=J+1	Q	30
966		CFS(J)=OCFS(I-1,L)+((TID-TIDH+DT(L))/DT(L))*(OCFS(I,L)-OCFS(I-1,L))	Q	31
967		TID=TID+DT(K)	Q	32
968	6	CONTINUE	Q	33
969		IEND(L)=J	Q	34
970		DT(L)=DT(K)	Q	35
971		DO 7 I=2,J	Q	36
972	7	OCFS(I,L)=CFS(I)	Q	37
973	8	IF (IEND(ID1)-IEND(ID2)) 9,9,10	Q	38
974	9	M=IEND(ID1)	Q	39
975		GO TO 11	Q	40
976	10	M=IEND(ID2)	Q	41
977	11	T2=TIME	Q	42
978	C	DETERMINE ERROR	Q	43
979		DO 12 I=1,M	Q	44
980		ERR=OCFS(I,ID1)-OCFS(I,ID2)	Q	45
981		WRITE (6,16) T2,OCFS(I,ID1),OCFS(I,ID2),ERR	Q	46
982		T2=T2+DT(ID1)	Q	47
983	C	SUM OF SQUARES OF ERROR	Q	48
984	12	SSE=SSE+ERR*ERR	Q	49
985		XM=M	Q	50
986	C	ERROR VARIANCE	Q	51
987		EVAR=SSE/XM	Q	52
988	C	ERROR STANDARD DEVIATION	Q	53
989		ESDEV=SQRT(EVAR)	Q	54
990		WRITE (6,17) ESDEV	Q	55
991	C	PERCENT ERROR FOR PEAK FLOWS	Q	56
992		ERPK=ABS(PEAK(ID1)-PEAK(ID2))	Q	57
993		PCTER=(ERPK/PEAK(ID1))*100.	Q	58
994		WRITE (6,18) PCTER	Q	59
995	C	PUNCH CODE	Q	60
996		IF (NPU) 14,14,13	Q	61
997	13	WRITE (7,19) ID1,ID2	Q	62
998	14	RETURN	Q	63
999	C		Q	64
1000	15	FORMAT(1H0,T33,'TIME',T55,'FLOW 1',T76,'FLOW 2',T95,'ERROR'/T34,	Q	65
1001		1'HRS',T57,'CFS',T78,'CFS',T97,'CFS')	Q	66
1002	16	FORMAT (20X,F20.3,F20.0)	Q	67
1003	17	FORMAT(1H0,T10,'ERROR STANDARD DEVIATION = ',F10.3)	Q	68
1004	18	FORMAT(T10,'PEAK DISCHARGE ERROR = ',F7.2,' PERCENT'///)	Q	69
1005	19	FORMAT('ERROR ANALYSIS',T21,'ID I=',I1,T29,'ID II=',I1)	Q	70
1006		END	Q	71
1007			Q	72

998		SUBROUTINE SEDT	R	1
	C	THIS SUBROUTINE COMPUTES THE SEDIMENT YIELD FOR A FLOOD	R	2
999		COMMON CFS(300),OCFS(300,6),IEND(6),DATA(310),DA(6),DP(20),NPU,NHD	R	3
		1,SCFS(20),C(20),A(20,6),Q(20,6),RAIN(200),DEEP(20,6),NER,MAXNO,NCO	R	4
		2MM,ICC,NCODE,DIST(6),SEGN(6),CTBLE(50,11),ITBLE(50,2),ZALFA(20),DT	R	5
		3(6),TIME,PEAK(6),ROIN,ISG(6)	R	6
1000		ID=DATA(1)	R	7
1001		SOIL=DATA(2)	R	8
1002		CROP=DATA(3)	R	9
1003		CP=DATA(4)	R	10
1004		SL=DATA(5)	R	11
	C	COMPUTE SEDIMENT YIELD	R	12
1005		X=ROIN*DA(ID)*53.333*PEAK(ID)	R	13
1006		SED=95.*X*.56*SOIL*CROP*CP*SL	R	14
1007		WRITE (6,3) SED	R	15
	C	PUNCH CODE	R	16
1008		IF (NPU) 2,2,1	R	17
1009	1	WRITE (7,4) ID,SOIL,CROP,CP,SL	R	18
1010	2	RETURN	R	19
	C		R	20
1011	3	FORMAT (10X, 'SEDIMENT YIELD = ', F10.1, ' TONS')	R	21
1012	4	FORMAT('SEDIMENT YIELD',T21,'ID=',I1,T29,'SOIL=',F5.3,T42,'CROP	R	22
		1=',F5.3,T57,'CP=',F5.3,T70,'LS=',F5.3)	R	23
1013		END	R	24-
//\$DATA				

ZALFA = 1234567890 *.,-

COMMAND TABLE

START	1 2
STORE HYD	2310
RECALL HYD	3310
COMPUTE HYD	4310
PRINT HYD	5 2
PUNCH HYD	6 1
PLOT HYD	7 2
ADD HYD	8 4
STORE RATING CURVE	9100
COMPUTE RATING CURVE	10310
STORE TRAVEL TIME	11100
COMPUTE TRAVEL TIME	12 5
ROUTE	13 4
ROUTE RESERVOIR	14100
ERROR ANALYSIS	15 2
SEDIMENT YIELD	16 5
FINISH	17 0

